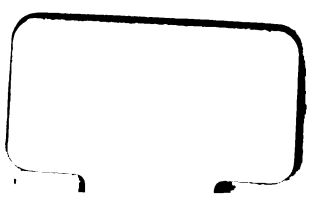


THE LABORATORY COMPANION

TO

FATS AND OILS INDUSTRIES

THE

LABORATORY COMPANION

TO

FATS AND OILS

INDUSTRIES

BY

DR. J. LEWKOWITSCH, M.A., F.I.C.

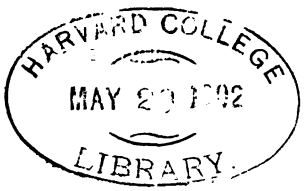
CONSULTING AND ANALYTICAL CHEMIST, AND CHEMICAL ENGINEER; EXAMINER IN 'SOAP MANUFACTURE,' AND IN 'FATS AND OILS, INCLUDING CANDLE MANUFACTURE,' TO THE CITY AND GUILDS OF LONDON INSTITUTE

London

MACMILLAN AND CO., LIMITED

NEW YORK: THE MACMILLAN COMPANY

1901



PREFACE

FOR several years past I have been contemplating the idea of collecting together in readily accessible tables all numerical values required in the examination of fats and oils. This book presents these in a handy form, which has stood the test of practical experience during the somewhat lengthy time this work has been in preparation.

The book consists almost exclusively of tables; the description of methods has not been given, nor has it been considered advisable to add any explanations as to the contents of the tables. Such information is contained in my *Chemical Analysis of Oils, Fats, and Waxes, and of the Commercial Products derived therefrom*, second edition (Macmillan and Co., 1898), to the pages of which the reader must be referred.

In Part I. only I have considered it necessary to introduce a few pages of subject matter explanatory of the system of fats and oils, as this has been considerably strengthened since the appearance of my *Chemical Analysis*. I may add that this Part I. should not be looked upon as merely a tabulated epitome of that work. A number of tables have been specially calculated to give further information and assistance in the interpretation of analytical results.

Part II. will, I hope, be found the most useful portion of the work. Numerical values, so-called constants, and variables, have been carefully scrutinised, and only the most reliable ones have been given. In some cases I had to decide on the most probable values.

It is hardly necessary to add that the literature of the subject has been taken note of down to the latest possible date, and that numerous values, extracted from my laboratory note-books, are

published here for the first time. Throughout this part the greatest attention has been paid to the requirements of the works chemist.

Part III. contains a few tables which are very frequently required, and are added to enhance the usefulness of this book as a laboratory manual. Some of these tables have been taken from Lunge and Böckmann's *Chemisch-technische Untersuchungsmethoden.*

J. LEWKOWITSCH.

LONDON, *September* 1901.

CONTENTS

PART I

SYSTEM AND EXAMINATION OF FATS AND WAXES

TABLES

PART II

FATS, OILS, AND WAXES, AND THE COMMERCIAL PRODUCTS DERIVED THEREFROM

TABLES

PART III

GENERAL TABLES

PART I

SYSTEM AND EXAMINATION OF FATS AND WAXES

A. SYSTEM OF FATS AND WAXES

FATTY OILS AND FATS

THE fatty oils (liquid fats) and fats occur in animals and plants in the form of the "neutral glycyl ethers" or "triglycerides." They are also termed "neutral oils and fats" in contradistinction to those oils (liquid fats) and fats which contain more or less considerable quantities of free fatty acids. The latter must be considered as having been derived from the neutral fats by a slow process of spontaneous decomposition, in the course of which diglycerides, monoglycerides, free fatty acids, and glycerol have been formed.

The following three tables (Tables Nos. 1, 2, and 3) contain a list of monoglycerides, diglycerides, and triglycerides hitherto isolated in a pure state, and their constants as far as ascertained.

The fatty oils (liquid fats) and fats consist of mixtures of the triglycerides, such as mentioned in Table No. 3, and, besides these, of other glycerides which have not yet been prepared in a pure state.

The triglycerides may be either glycerides of one fatty acid only or "mixed glycerides," *i.e.* a glyceride in which more than one fatty acid is combined with glycerol, such as oleodistearin.

The most convenient classification of fatty oils (liquid fats) and fats for practical purposes can be based on the magnitude of the iodine value. This principle includes their subdivision into oils (liquid fats) and solid fats, according to their consistency, and also that based on their capability of absorbing oxygen, more or less rapidly, on exposure to the air at the ordinary temperature.

Arranging then, according to the iodine value, we obtain the following subdivisions, taking as two parallel branches the vegetable fats on the one hand, and animal fats on the other, not only for the sake of convenience but also for the further reason that vegetable fats can be chemically differentiated from animal fats by the occurrence of phytosterol in the former, whereas animal fats are recognised by the presence of cholesterol.

I. Liquid Fats or Fatty Oils

A. Vegetable Oils—
1. Drying Oils.
2. Semi-Drying Oils.
3. Non-Drying Oils.

B. Animal Oils—
1. Marine Animal Oils.
(*a*) Fish Oils.
(*b*) Liver Oils.
(*c*) Blubber Oils.
2. Terrestrial Animal Oils.

II. Solid Fats

A. Vegetable Fats.

B. Animal Fats.
1. Drying.
2. Non-Drying.

WAXES

The waxes are, chemically considered, ethers formed by the union of fatty acids and of alcohols, not belonging to the glycerol series. Hence, by the absence of glycerol they are sharply differentiated from the oils and fats with which they have many physical properties in common. The constants of a number of "waxes" isolated in the pure state are collated in Table No. 4.

The natural waxes also, may be conveniently classified according to their iodine values, with subdivisions, in a similar manner to that adopted for fatty oils and fats, as follows:—

I. Liquid Waxes

II. Solid Waxes
A. Vegetable Waxes.
B. Animal Waxes.

All the better known natural fats and waxes are tabulated according to the foregoing classification, together with their origins, yields, and those numbers which are employed in analysis for their identification and examination in the tables in Part II., headed Tables 24.

B. SAPONIFICATION OF FATS AND WAXES

The saponification of fats takes place according to the following equation:—

$$\begin{matrix} O.R \\ C_3H_5\,O.R \\ O.R \end{matrix} + 3M.OH = \begin{matrix} O.M \\ C_3H_5\,O.M \\ O.M \end{matrix} + 3R.OH,$$

where R denotes the radicle of any fatty acid, and M stands for a monovalent metal or hydrogen.

In the light of experiments made by Geitel and by the author, this

equation must be considered as a summary of the following three equations :—

$$C_3H_5\begin{matrix}O.R\\O.R\\O.R\end{matrix} + MOH = C_3H_5\begin{matrix}O.M\\O.R\\O.R\end{matrix} + R.OH,$$

$$C_3H_5\begin{matrix}O.M\\O.R\\O.R\end{matrix} + MOH = C_3H_5\begin{matrix}O.M\\O.M\\O.R\end{matrix} + R.OH,$$

$$C_3H_5\begin{matrix}O.M\\O.M\\O.R\end{matrix} + MOH = C_3H_5\begin{matrix}O.M\\O.M\\O.M\end{matrix} + R.OH,$$

expressing the fact that saponification takes place in three stages, passing from the triglyceride through the diglyceride and monoglyceride to the products of complete saponification, namely, free fatty acid and glycerol.

The difference between the old view and the new view finds its numerical expression in the Table No. 5, where the percentages of glycerol to be expected from a pure triglyceride, as saponification progresses, are placed side by side with the percentages of free fatty acids formed simultaneously.

The saponification of waxes takes place according to the following equation :—

$$C_nH_{2n+1}CO.O.C_nH_{2m+1} + MOH = C_nH_{2n+1}CO.OM + C_nH_{2m+1}OH.$$

The different constituents into which fats and waxes are resolved by the process of saponification are enumerated in the Tables Nos. 6 and 7, together with those constants that have been determined hitherto. To the table of naturally occurring fatty acids there are added in an Appendix the constants of some hydroxylated and dibasic acids that are met with in products of the fat and oil industries.

C. EXAMINATION OF FATS AND WAXES

The examination of a fat or wax must be preceded by its purification from foreign substances. This is attained by extracting the fatty matter with a volatile solvent, and evaporating off the latter.

The purified fat or wax is then examined by the following general physical, and chemical methods. (Only in special cases detection and determination of sulphur, phosphorus, metals, etc., is required.)

Physical Methods

The physical methods are confined chiefly to the determination of the

(*a*) Specific gravity.
(*b*) Melting and solidifying points.
(*c*) Refractive power

The constants ascertained hitherto are stated in the Tables No. 24 in Part II.

For the determination of the solidifying point at low temperatures it is necessary to employ freezing mixtures, such as those given in Table No. 8.

The determination of the viscosity will in some cases give useful indications; but hitherto the viscosity has not become of sufficient importance as a constant to be able to afford discriminative value. Tables giving the viscosities will be found under the heading "Lubricants," Tables No. 25 in Part II.

Chemical Methods

The chemical methods in use refer, in the first instance, to the determination of the "constants" or "quantitative reactions." They comprise the following values:—

(*a*) Saponification value.
(*b*) Reichert value, or Reichert-Meissl value.
(*c*) Insoluble fatty acids + Unsaponifiable (Hehner value).
(*d*) Iodine value.

As a guide to the proper interpretation of the numbers so obtained and set out in the general Tables No. 24 in Part II, the Tables Nos. 9, 10, and 11 will be found useful.

Table No. 9 gives the saponification values, percentages of insoluble fatty acids (Hehner values), and yields of glycerol of mono-, di-, and triglycerides of the most frequently occurring fatty acids.

Table No. 10 states the iodine values of unsaturated fatty acids, and of their corresponding mono-, di-, and triglycerides. For the purpose of rapidly calculating the iodine value, Table No. 11 gives the logarithms of the quotient $\frac{0{\cdot}2}{\text{c.c. thiosulphate}}$ for the most frequently occurring numbers.

Table No. 12 will be found useful in the interpretation of results obtained in the examination of waxes.

Besides these constants it is often required to determine the

(*a*) Acetyl value,
(*b*) Acid value,
(*c*) Unsaponifiable matter,

since from these numbers important conclusions can be derived as to the valuation of a fat or wax under examination. These numbers not being "constants," but varying with the mode of purification and with other accidental circumstances, have been comprised under the heading "Variables" in Tables No. 24, Part II.

A reservation must, however, be made with regard to the acetyl value, which in some cases must be considered a "constant," as in castor oil (and generally in the case of triglycerides of hydroxylated fatty acids), and alcohols. Tables No. 13 and No. 14 will afford the necessary guidance in the interpretation of experimental data.

Table No. 15 gives the "acid values" of a number of pure fatty acids. The acid value is frequently expressed in terms of oleic acid. Table No. 16 will assist in readily converting one term into another.

The examination of the unsaponifiable matter will be materially expedited by a reference to Table No. 17.

Besides these foregoing methods, we have a number of chemical reactions which have not yet attained to the rank of quantitative reactions, and are usually comprised under the name of qualitative reactions. They include:—

(*a*) The Elaïdin test, Table No. 18;
(*b*) The Sulphur Chloride test, Table No. 19;
(*c*) The Thermal test, cp. Tables No. 24 in Part II; and
(*d*) The Oxygen Absorption test, Tables Nos. 20 and 21, cp. also "Oxidised Oils," Part II.

For the further examination of the fatty acids and their separation into individual fatty acids, scientific methods must be resorted to. Those hitherto used are, however, not expeditious enough for general application. They comprise, in the first instance, the separation of the volatile from the non-volatile fatty acids, and then the separation of the solid fatty acids from the liquid acids.

An insight into the nature of the latter is obtained by examining the oxidation products on the one hand and the bromination products on the other. The Tables Nos. 22 and 23 give the numbers obtained hitherto for the best examined substances.

TABLE No. 1.—

	Monoglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.
				°C.	–	°C.
1	Mono-formin . . .	$C_3H_5(O.CHO)(OH)_2$	120	...	...	...
2	Mono-acetin . . .	$C_3H_5(O.C_2H_3O)(OH)_2$	134	$\frac{15}{15}$	1·2212	...
3	Mono-butyrin . . .	$C_3H_5(O.C_4H_7O)(OH)_2$	162	17	1·088	...
4	Mono-isovalerin . .	$C_3H_5(O.C_5H_9O)(OH)_2$	176	16	1·100	
5	Mono-palmitin . . .	$C_3H_5(O.C_{16}H_{31}O)(OH)_2$	330	...	...	...
6	Mono-stearin . . .	$C_3H_5(O.C_{18}H_{35}O)(OH)_2$	358	...	...	...
7	Mono-arachin . . .	$C_3H_5(O.C_{20}H_{39}O)(OH)_2$	386	...	...	...
8	Mono-cerotin . . .	$C_3H_5(O.C_{26}H_{51}O)(OH)_2$	470	...	...	...
9	Mono-melissin . . .	$C_3H_5(O.C_{30}H_{59}O)(OH)_2$	526	...	...	...
10	Mono-olein . . .	$C_3H_5(O.C_{18}H_{33}O)(OH)_2$	356	21	0·947	15-20

TABLE No. 2.—

	Diglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.
				°C.	–	°C.
1	Di-formin . . .	$C_3H_5(O.CHO)_2OH$	148	15	1·304	...
2	Di-acetin	$C_3H_5(O.C_2H_3O)_2OH$	176	$\frac{15}{15}$	1·1769-1·1788	...
3	Di-butyrin . . .	$C_3H_5(O.C_4H_7O)_2OH$	232	17	1·083	
4	Di-isovalerin . . .	$C_3H_5(O.C_5H_9O)_2OH$	260	16	1·059	
5	Di-palmitin . . .	$C_3H_5(O.C_{16}H_{31}O)_2OH$	568	...	...	...
6	Di-stearin . . .	$C_3H_5(O.C_{18}H_{35}O)_2OH$	624	...	...	...
7	Di-arachin . . .	$C_3H_5(O.C_{20}H_{39}O)_2OH$	680	...	...	...
8	Di-cerotin . . .	$C_3H_5(O.C_{26}H_{51}O)_2OH$	848	...	...	...
9	Di-melissin . . .	$C_3H_5(O.C_{30}H_{59}O)_2OH$	940	...	...	...
10	Di-olein	$C_3H_5(O.C_{18}H_{33}O)_2OH$	620	21	0·921	10-15
11	Di-erucin	$C_3H_5(O.C_{22}H_{41}O)_2OH$	732	...	...	...
12	Di-brassidin . . .	$C_3H_5(O.C_{22}H_{41}O)_2OH$	732	...	...	...

Monoglycerides

Melting Point.	Boiling Point.		Solubility.	
°C.	m.m. Pressure.	°C.		
...	0	165		1
...	2-3	130-132	Easily soluble in water and alcohol; very sparingly soluble in ether, and almost insoluble in benzene.	2
...	...	...	8 volumes are miscible with 3 volumes of water; with 5 or more volumes of water an emulsion is formed.	3
				4
63	...	...	100 parts absolute alcohol dissolve 5·306 parts at 22·5° C.	5
61	...	...	Sparingly soluble in cold ether; dissolves easily in hot alcohol and ether.	6
...	...	...	Nearly insoluble in cold ether.	7
78·8				8
91·5-92·0				9
				10

Diglycerides

Melting Point.	Boiling Point.		Solubility.	
°C.	m.m. Pressure.	°C.		
...	20-30	163-166		1
...	40	175-176	Easily soluble in water and alcohol; less readily in ether, and	2
	760	259-261	with difficulty in benzene.	
				3
				4
61	...	...	100 parts absolute alcohol dissolve { 0·2097 parts at 20° C. / 0·5040 ,, 27° C. }	5
76·5	...	...	Sparingly soluble in cold alcohol; dissolves in 150 parts hot alcohol. Easily soluble in warm ether, chloroform, benzene, and petroleum ether.	6
75	...	...	Almost insoluble in cold ether; soluble in CS_2.	7
79·5	...	...	Almost insoluble in boiling alcohol.	8
93·0				9
				10
47·0	...	...	Almost insoluble in cold alcohol; dissolves readily in ether and petroleum ether.	11
67·0	...	...	Sparingly soluble in ether.	12

TABLE No. 3.—

	Triglycerides.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.
				°C.	–	°C.	°C.
1	Acetin	$C_3H_5(O.C_2H_3O)_3$	218	$\frac{15}{15}$	1·1603	...	...
2	Butyrin	$C_3H_5(O.C_4H_7O)_3$	302	8	1·056	...	...
				$\frac{20}{4}$	1·0324	...	...
				$\frac{40}{4}$	1·0143	...	...
				$\frac{60}{4}$	0·9963	...	...
3	Valerin, Iso-	$C_3H_5(O.C_5H_9O)_3$	344	...	...	...	...
4	Caproin	$C_3H_5(O.C_6H_{11}O)_3$	386	$\frac{20}{4}$	0·9817	– 60	– 25
				$\frac{40}{4}$	0·9651	...	...
				$\frac{60}{4}$	0·9494	...	...
5	Caprylin	$C_3H_5(O.C_8H_{15}O)_3$	470	$\frac{20}{4}$	0·9540	– 15	8·0-8·3
				$\frac{40}{4}$	0·9382	...	...
				$\frac{60}{4}$	0·9231	...	...
6	Caprin	$C_3H_5(O.C_{10}H_{19}O)_3$	554	$\frac{40}{4}$	0·9205	...	31·1
				$\frac{60}{4}$	0·9057	...	...
7	Laurin	$C_3H_5(O.C_{12}H_{23}O)_3$	638	$\frac{60}{4}$	0·8944	...	46·4
				$\frac{100}{4}$	0·8687	...	...
8	Myristin	$C_3H_5(O.C_{14}H_{27}O)_3$	722	$\frac{60}{4}$	0·8848	...	56·5
9	Palmitin	$C_3H_5(O.C_{16}H_{31}O)_3$	806	$\frac{80}{4}$	0·8657	45-47	65·1
10	Stearin	$C_3H_5(O.C_{18}H_{35}O)_3$	890	65·5	0·9235	70·0	71·6
				$\frac{80}{4}$	0·8621	...	...
11	Arachin	$C_3H_5(O.C_{20}H_{39}O)_3$	974	...	...	...	...
12	Cerotin	$C_3H_5(O.C_{26}H_{51}O)_3$	1226	...	...	...	76·5-77
13	Melissin	$C_3H_5(O.C_{30}H_{59}O)_3$	1394	...	...	...	89
14	Olein	$C_3H_5(O.C_{18}H_{33}O)_3$	884	15	0·900	...	...
15	Elaïdin	$C_3H_5(O.C_{18}H_{33}O)_3$	884	...	...	...	38
16	Erucin	$C_3H_5(O.C_{22}H_{41}O)_3$	1052	...	...	...	31·0
17	Brassidin	$C_3H_5(O.C_{22}H_{41}O)_3$	1052	...	...	...	47·0
18	Ricinolein	$C_3H_5(O.C_{18}H_{33}O_2)_3$	932	...	0·959-0·984	– 60	– 25
	Mixed Glycerides—						
19	Acetodiformin	$C_3H_5(O.C_2H_3O)(O.CHO)_2$	190	0	1·2490	...	...
20	Oleodistearin	$C_3H_5(O.C_{18}H_{33}O)(O.C_{18}H_{35}O)_2$	888	70	0·8928	40·8	45-46
21	Elaïdodistearin	$C_3H_5(O.C_{18}H_{33}O)(O.C_{18}H_{35}O)_2$	888	...	...	...	61

Triglycerides

Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
m.m. Pressure.	°C.	°C.	n_D.			
40	172-172·5	15	1·4328	Miscible with alcohol, ether, chloroform, benzene. Insoluble in CS_2 and petroleum ether. Slightly soluble in water.		1
760	258-259					
10	186	20	1·4587	Soluble in absolute, and 85 per cent alcohol, and the usual organic solvents.	Cow butter.	2
760	285	20	1·48587	Nearly insoluble in water.		
...	...	40	1·42785			
...	...	60	1·42015			
...	...	...	...	...	Dolphin oil, porpoise oil.	3
...	...	20	1·44265	Miscible with 85 per cent alcohol and the usual organic solvents at the ordinary temperature.	Cow butter, cocoa nut oil.	4
...	...	40	1·43502			
...	...	60	1·42715			
...	...	20	1·44817	Miscible with 85 per cent alcohol and the usual organic solvents at the ordinary temperature.	Cow butter, cocoa nut oil.	5
...	...	40	1·44069			
...	...	60	1·43316			
...	...	40	1·44461	Dissolves sparingly in absolute alcohol at the ordinary temperature, but readily in hot alcohol, as also in the usual organic solvents.	Cow butter, cocoa nut oil.	6
...	...	60	1·43697			
...	...	60	1·44039	Sparingly soluble in cold absolute alcohol; easily soluble in the usual organic solvents, and in hot absolute alcohol.	Laurel oil.	7
...	...	100	1·4246		Tangkallah fat, cocoa nut oil.	
...	...	60	1·44285	Very sparingly soluble in cold absolute alcohol; easily soluble in hot absolute alcohol, and in the usual organic solvents.	Nutmeg butter, dika oil.	8
...	...	80	1·43807	Almost insoluble in cold absolute alcohol, dissolves in hot alcohol and in the usual organic solvents.	Most fats and oils.	9
...	...	...	...	Almost insoluble in cold absolute alcohol, more soluble in hot absolute alcohol. Sparingly soluble in cold ether and petroleum ether; readily in the hot solvents. Dissolves readily in cold benzene and chloroform.	Most fats and oils.	10
...	...	80	1·43987			
...	...	...	...	Very slightly soluble in ether.	Arachis oil.	11
...	...	...	...	Very slightly soluble in ether.		12
						13
...	...	...	...	Insoluble in dilute alcohol; more readily soluble in absolute alcohol than palmitin or stearin. Easily soluble in the usual organic solvents.	Most fats and oils.	14
						15
...	...	...	...	Nearly insoluble in alcohol; readily soluble in the usual organic solvents.	Rape oil.	16
						17
760	360	...	...	Miscible with absolute alcohol and glacial acetic acid; soluble in 96 per cent alcohol and methyl alcohol. Sparingly soluble in petroleum ether.	Castor oil.	18
						19
27	157	...	...	...	Mkanyi fat, kokum butter.	20
						21

TABLE NO. 4.—*Waxes*

Waxes.	Formula.	Molecular Weight.	Solidifying Point. °C.	Melting Point. °C.	Solubility.	Occurrence.
Cetyl Palmitate, Cetin	$C_{16}H_{33}.O.CO.C_{15}H_{31}$	480	...	55	Nearly insoluble in cold alcohol; easily soluble in boiling alcohol	Spermaceti
Octodecyl Palmitate	$C_{18}H_{37}.O.CO.C_{15}H_{31}$	508	...	59		
Ceryl Palmitate	$C_{26}H_{53}.O.CO.C_{15}H_{31}$	620	76	79	...	Opium wax
Myricyl Palmitate, Myricin	$C_{30}H_{61}.O.CO.C_{15}H_{31}$	676	...	72	...	Beeswax
Cetyl Stearate	$C_{16}H_{33}.O.CO.C_{17}H_{35}$	508	...	55-60		
Ceryl Cerotate	$C_{26}H_{53}.O.CO.C_{25}H_{53}$	762	...	82·5	...	Chinese wax
Cocceryl Coccerate, Coccerin	$C_{30}H_{60}(O.C_{31}H_{61}O_2)_2$	1382	...	106	Nearly insoluble in cold alcohol or ether; dissolves with great difficulty in cold benzene and glacial acetic acid	Cochineal wax
Cholesteryl Palmitate	$C_{26}H_{43}.O.CO.C_{15}H_{31}$	610	...	77-78	...	Blood serum
Cholesteryl Oleate	$C_{26}H_{43}.O.CO.C_{17}H_{33}$	636	...	41	Soluble in ether, chloroform, and benzene; but only sparingly soluble in alcohol	Blood serum
Cholesteryl Stearate	$C_{26}H_{43}.O.CO.C_{17}H_{35}$	638	...	65	Nearly insoluble in alcohol; slightly soluble in ether	
Isocholesteryl Stearate	$C_{26}H_{43}.O.CO.C_{17}H_{35}$	638	...	72	Very slightly soluble in boiling alcohol	
Cholesteryl Cerotate	$C_{26}H_{43}.O.CO.C_{26}H_{53}$	764	...	85·5		

TABLE No. 5.—*Saponification of a Pure Triglyceride*
(Molecular Weight 860)

OLD THEORY.		NEW THEORY.	
Fatty Acids.	Glycerol.	Fatty Acids.	Glycerol.
Per cent.	Per cent.	Per cent.	Per cent.
95·52	10·85	95·52	10·85
95·31	10·82	95·69	10·429
95·09	10·78	95·88	9·975
94·86	10·72	96·07	9·538
94·65	10·58	96·31	8·910
94·45	10·27	96·68	8·019
94·37	9·82	96·80	7·767
94·69	8·47	97·94	4·985
95·77	6·34	98·51	3·681
97·33	3·86	99·24	1·837
97·54	3·32	99·39	1·466
98·20	2·45	99·52	1·115
98·98	1·51	99·69	0·743
99·53	0·67	99·85	0·372
100·00	0·00	100·0	0·00

TABLE No. 6.

	Acids.	Formula.	Molecular Weight.	Specific Gravity. °C.	Specific Gravity. –	Solidifying Point. °C.	Melting Point. °C.
	Acids, $C_nH_{2n}O_2$—						
1	Acetic	$C_2H_4O_2$	60	15	1·0515	+17·5	...
			...	86	1·0064		
2	Butyric	$C_4H_8O_2$	88	0	0·9746	−19	−6·5
				14	0·9580	...	−7·9
				$\frac{19\cdot1}{4}$	0·9599		
				$\frac{20}{4}$	0·9590		
				$\frac{30\cdot2}{4}$	0·8983		
				$\frac{101\cdot5}{4}$	0·8141		
3	Valeric, Iso- . . .	$C_5H_{10}O_2=(CH_3)_2.CH.CH_2.CO_2H$	102	0	0·9467	−57	−51
			...	20	0·9310		
4	Caproic	$C_6H_{12}O_2$	116	$\frac{20}{4}$	0·9274	below	...
				40	0·917	−18	
5	Caprylic	$C_8H_{16}O_2$	144	0	0·9270	12	16·5
				$\frac{20}{4}$	0·9100	...	...
6	Capric	$C_{10}H_{20}O_2$	172	$\frac{40}{4}$	0·8858	...	31·3-31·4
7	Umbellulic	$C_{11}H_{22}O_2$	186	...	...	...	21-23
8	Lauric	$C_{12}H_{24}O_2$	200	$\frac{20}{4}$	0·883	...	43·6
				$\frac{43\cdot6}{4}$	0·875	...	...
				$\frac{60}{4}$	0·8642	...	...
				$\frac{78\cdot6}{4}$	0·8495	...	...
9	Myristic	$C_{14}H_{28}O_2$	228	$\frac{53\cdot8}{4}$	0·8622	...	53·8
				$\frac{60}{4}$	0·8584	...	...
10	Isocetic	$C_{15}H_{30}O_2$ (?)	242	...	...	...	55
11	Palmitic	$C_{16}H_{32}O_2$	256	$\frac{62}{4}$	0·8527	62·6	62·62
				$\frac{75\cdot8}{4}$	0·8465	...	...
				$\frac{80}{4}$	0·8412	...	...
12	Daturic	$C_{17}H_{34}O_2$	270	...	...	...	54·5; 57
13	Stearic	$C_{18}H_{36}O_2$	284	11	1·0000	69·3	69·32
				$\frac{69\cdot2}{4}$	0·8454	...	...
				$\frac{80}{4}$	0·8386	...	...
14	Arachidic	$C_{20}H_{40}O_2$	312	...	...	...	77
15	Behenic	$C_{22}H_{44}O_2$	340	...	...	79-77	83-84
16	Lignoceric	$C_{24}H_{48}O_2$	368	...	...	...	80·5
17	Carnaübic	$C_{24}H_{48}O_2$	368	...	...	69-67	72·5
18	Hyænic	$C_{25}H_{50}O_2$	382	...	...	...	77-78
19	Cerotic	$C_{26}H_{52}O_2$	396	$\frac{79}{4}$	0·8359	...	77·8
20	Melissic	$C_{30}H_{60}O_2$	452	...	...	...	91

—*Fatty Acids*

Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
m.m. Pressure.	°C.	°C.	n_D.			
760	118·1	...	...	Miscible with water, alcohol and ether in all proportions	Macassar oil.	1
760	162·3	20	1·39906	...	Cow butter.	2
10·48	72·4	...	...	Dissolves in 23·6 parts of water	Porpoise oil, dolphin oil.	3
45·92	199·2					
760	173·7					
732	199·7	20	1·41635	Not miscible with water, though slightly soluble in it	Cow butter, cocoa nut oil.	4
10	123·5-124·3	20	1·42825	Soluble in 400 parts of boiling water; very sparingly soluble in cold water	Cow butter, cocoa nut oil, human fat.	5
761	236-237					
13	153-154	40	1·42855	Sparingly soluble in boiling water; nearly insoluble in cold water	Cow butter, cocoa nut oil.	6
100	199·5-200					
760	268-270					
760	275-280	...	...	...	Chaulmoogra oil.	7
0	102	60	1·42665	Very slightly soluble in boiling water	Laurel oil, cocoa nut oil.	8
15	176					
16	180					
100	225					
0	121-122	60	1·43075	Completely insoluble in water; dissolves with difficulty in cold alcohol and ether	Nutmeg butter; dika oil, quince oil, cocoa nut oil. Spermaceti, wool wax.	9
15	196·5					
100	250·5					
...	...	...	...	...	Curcas oil.	10
0	138-139	80	1·42693	Not readily soluble in cold alcohol, nor in cold petroleum ether. Easily soluble in both menstrua in the hot	Most animal and vegetable fats; beeswax, spermaceti.	11
15	215					
100	271·5					
15	223-225	...	...	...	Seeds of thorn-apple.	12
0	154·5-155·5	80	1·43003	Less soluble in cold alcohol than palmitic acid	Most animal and vegetable fats.	13
15	232					
100	291					
760	360					
...	...	...	...	...	Arachis oil, rambutan tallow, rape oil, maize oil.	14
...	...	...	...	100 parts alcohol of 90 per cent by volume dissolve at 17° C.: 0·102 grms. 100 parts ether dissolve at 16° C.: 1·922 grms.	Ben oil.	15
...	...	...	...	Very sparingly soluble in cold alcohol	Arachis oil.	16
...	...	...	...	Sparingly soluble in cold methyl alcohol	Carnaüba wax, wool wax.	17
						18
...	...	...	...	Almost insoluble in cold alcohol; soluble in boiling alcohol	Carnaüba wax, beeswax.	19
...	...	...	...	Almost insoluble in ether and methyl alcohol	Beeswax.	20

TABLE No. 6, *con-*

	Acids.	Formula.	Molecular Weight.	Specific Gravity. °C.	Specific Gravity. –	Solidifying Point. °C.	Melting Point. °C.
	Acids, $C_nH_{2n-2}O_2$—						
1	Tiglic	$C_5H_8O_2$	100	$\frac{7.6}{4}$	0·9641	...	64·5
2	Hypogæic	$C_{16}H_{30}O_2$	254	...	...	...	33-34
3	Gaïdic	$C_{16}H_{30}O_2$	254	...	...	...	39
4	Physetoleic	$C_{16}H_{30}O_2$	254	...	...	...	30
5	Lycopodic	$C_{16}H_{30}O_2$	254	...	...	...	...
6	Oleic	$C_{18}H_{34}O_2$	282	$\frac{11.8}{4}$	0·8908	4	14
				115	0·898	...	...
				20	0·895	...	...
				30	0·889	...	...
				50	0·875	...	...
				$\frac{78.4}{4}$	0·8540	...	...
7	Elaïdic	$C_{18}H_{34}O_2$	282	$\frac{79.4}{4}$	0·8505	...	44·5
8	Isooleic	$C_{18}H_{34}O_2$	282	...	...	...	44-45
9	Rapic	$C_{18}H_{34}O_2$	282	...	...	...	...
10	Doeglic	$C_{19}H_{36}O_2$	296	...	...	...	...
11	Jecoleic	$C_{19}H_{36}O_2$	296	...	...	...	...
12	Erucic	$C_{21}H_{42}O_2$	338	$\frac{55}{4}$	0·8602	...	33-34
13	Brassidic	$C_{22}H_{42}O_2$	338	$\frac{57.1}{4}$	0·8585	56	65-66
14	Isoerucic	$C_{22}H_{42}O_2$	338	...	...	52-51	54-56
	Acids, $C_nH_{2n-4}O_2$—						
15	Elæomargaric	$C_{17}H_{30}O_2$	266	...	...	...	48
16	Elæostearic	$C_{17}H_{30}O_2$	266	...	...	...	71
17	Linolic	$C_{18}H_{32}O_2$	280	14	0·9206	below −18	...
18	Tariric	$C_{18}H_{32}O_2$	280	...	...	...	50·5
19	Telfairic	$C_{18}H_{32}O_2$	280	...	...	6	...
	Acids, $C_nH_{2n-6}O_2$—						
20	Linolenic	$C_{18}H_{30}O_2$	278	$\frac{15.5}{15.5}$	0·9228	...	...
21	Isolinolenic	$C_{18}H_{30}O_2$	278	...	...	...	...
	Acids, $C_nH_{2n-8}O_2$—						
22	Isanic	$C_{14}H_{20}O_2$	220	...	...	...	41

tinued.—Fatty Acids

Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
m.m. Pressure.	°C.	°C.	n_D.			
760	198·5	...	...	Dissolves sparingly in cold, easily in hot water	Croton oil.	1
10	230	...	...	...	Arachis oil, maize oil.	2
15	236					3
...	...	...	...	...	Caspian seal oil.	4
...	...	...	...	...	Spores of Lycopodium.	5
0	153	15	1·4638	Insoluble in water; readily soluble in alcohol, even if somewhat dilute	Most animal and vegetable oils.	6
10	223	20	1·4620			
15	232·5	30	1·4585			
30	249·5	40	1·4546			
50	264·0	50	1·4509			
100	285·5-286	60	1·4471			
0	154					7
10	225					
15	234					
30	251·5					
50	266					
100	287·8-288					
...	...	...	...	Very easily soluble in alcohol, less readily in ether	Distilled stearine.	8
...	...	...	...	...	Rape oil.	9
...	...	...	...	...	Arctic sperm oil.	10
...	...	...	...	...	Cod liver oil (?).	11
0	179	...	...	Very easily soluble in alcohol	Rape oil, mustard seed oils, fish oils (?).	12
10	254·5					
15	264					
30	281					
0	160					13
10	256					
15	265					
30	282					
...	...	...	...	Sparingly soluble in alcohol and ether		14
...	...	...	...	...	Chinese wood oil.	15
						16
...	...	...	...	Dissolves readily in alcohol and ether	Drying oils.	17
...	...	...	...	...	Fat from Picramnia.	18
13	220-225	...	...	...	Koëme oil.	19
...	...	...	...	...	Drying oils.	20
...	...	...	...	...	Linseed oil.	21
...	...	...	...	Readily soluble in alcohol and the usual organic solvents	Seeds from I'sano.	22

TABLE NO. 6, *con-*

	Acids.	Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.	Melting Point.
				°C.	–	°C.	°C.
1	Therapic (?)	$C_{17}H_{26}O_2$	262	...	...	...	...
2	?	$C_{20}H_{32}O_2$	304	...	...	...	...
3	?	$C_{24}H_{40}O_2$	360	...	...	...	...
	Acids, $C_nH_{2n}O_3$—						
4	Lanopalmic	$C_{16}H_{32}O_3$	272	...	...	85-83	87-88
5	Cocceric	$C_{31}H_{62}O_3$	482	...	...	...	92-93
	Acids, $C_nH_{2n-2}O_3$—						
6	Ricinoleic	$C_{18}H_{34}O_3$	298	15·5	0·9509	– 6· – 10	4-5
7	Ricinelaïdic	$C_{18}H_{34}O_3$	298	...	...	...	52-53
8	Ricinic	$C_{18}H_{34}O_3$	298	...	...	...	81
9	?	$C_{18}H_{34}O_3$	298	...	0·8931	...	...
	Acids, $C_nH_{2n}O_4$—						
	Monobasic Acids—						
10	Dihydroxystearic	$C_{18}H_{36}O_4$	316	...	...	...	141-143
11	Lanoceric	$C_{30}H_{60}O_4$	484	...	...	103-101	104-105
	Acids, $C_nH_{2n-2}O_4$—						
	Dibasic Acids—						
12	Japanic	$C_{20}H_{40}(COOH)_2$	370	...	>1·0	...	117·7-117·9
	APPENDIX						
	I. Hydroxylated Acids—						
	(*a*) *Monohydroxylated Acids*, $C_nH_{2n}O_3$—						
13	β-Hydroxystearic	$C_{18}H_{35}O_2(OH)$	300	...	...	68-65	83-85
14	α-Hydroxystearic	$C_{18}H_{35}O_2(OH)$	300	...	...	...	77-79
15	Lactone of γ-Hydroxystearic (Stearolactone)	$C_{18}H_{34}O_2$	282	...	...	...	47-48
	(*b*) *Dihydroxylated Acids*, $C_nH_{2n}O_4$—						
16	Tigliceric (Dihydroxytiglic)	$C_5H_8O_2(OH)_2$	134	...	...	...	88
17	Di-hydroxypalmitic	$C_{16}H_{30}O_2(OH)_2$	288	...	...	...	115
18	Di-hydroxystearic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	122-119	136·5
19	Di-hydroxystearidic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	...	99-100
20	p-Di-hydroxystearic	$C_{18}H_{34}O_2(OH)_2$	316	...	...	...	79
21	Di-hydroxyjecoleic	$C_{19}H_{36}O_2(OH)_2$	330	...	...	...	114-116
22	Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	...	132-133
23	Iso-Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	88-87	99-100
24	p-Di-hydroxybehenic	$C_{22}H_{42}O_2(OH)_2$	372	...	...	82-80	86-88

tinued.—Fatty Acids

Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
m.m. Pressure.	°C.	°C	n_D.			
...	...	...	...	...	Cod liver oil.	1
...	...	...	...	...	Cod liver oil.	2
...	...	...	...	...	Cod liver oil.	3
...	...	...	...	Insoluble in water, but dissolves in it in presence of alcohol on boiling; soluble in the usual organic solvents	Wool wax.	4
...	...	...	...	Dissolves sparingly in cold alcohol, ether, benzene, petroleum ether, and glacial acetic acid	Cochineal wax.	5
15	250	...	...	Easily soluble in alcohol and ether	Castor oil.	6
						7
15	250-252					8
...	...	...	...	...	Quince oil.	9
...	...	...	...	Insoluble in ether, petroleum ether, benzene; dissolves in boiling alcohol	Castor oil.	10
...	...	...	...	Sparingly soluble in ether and warm benzene	Wool wax.	11
...	...	...	...	Sparingly soluble in the usual solvents	Japan wax.	12
...	...	...	...	Sparingly soluble in alcohol and ether		13
...	...	...	...	More readily soluble in ether, and less in absolute alcohol than the β-acid		14
...	...	...	...	Insoluble in water; dissolves easily in alcohol ether, and petroleum ether		15
...	...	...	...	Easily soluble in water; soluble in alcohol and acetone; insoluble in petroleum ether, chloroform, and benzene		16
...	...	...	...	Readily soluble in alcohol and ether		17
...	...	...	...	Completely insoluble in water; not readily soluble in cold alcohol; sparingly soluble in ether		18
						19
...	...	...	...	Easily soluble in alcohol and ether		20
						21
...	...	...	...	Dissolves readily in warm alcohol; insoluble in cold ether		22
						23
						24

TABLE NO. 6, *con-*

	Acids.	Formula.	Molecular Weight.	Specific Gravity. °C.	Specific Gravity. –	Solidifying Point. °C.	Melting point. °C.
	(*c*) *Trihydroxylated Acids*, $C_nH_{2n}O_5$—						
1	Tri-hydroxystearic . .	$C_{18}H_{33}O_2(OH)_3$	332	...	..	...	140-142
2	α-Iso-tri-hydroxystearic .	$C_{18}H_{33}O_2(OH)_3$	332	...	...	...	110-111
3	β-Iso-tri-hydroxystearic .	$C_{18}H_{33}O_2(OH)_3$	332	...	...	...	114-115
	(*d*) *Tetrahydroxylated Acid*, $C_nH_{2n}O_6$—						
4	Sativic	$C_{18}H_{32}O_2(OH)_4$	348	...	...	...	173
	(*e*) *Hexahydroxylated Acids*, $C_nH_{2n}O_8$—						
5	Linusic	$C_{18}H_{30}O_2(OH)_6$	380	...	...	...	203-205
6	Isolinusic	$C_{18}H_{30}O_2(OH)_6$	380	...	...	...	173-175
	II. Dibasic Acids—						
7	Suberic	$C_6H_{12}(COOH)_2$	174	...	...	...	140
8	Azelaic	$C_7H_{14}(COOH)_2$	188	...	...	...	106·2
9	Sebacic	$C_8H_{16}(COOH)_2$	202	...	...	...	133-133·5

tinued.—Fatty Acids

Boiling Point.		Refractive Index.		Solubility.	Occurrence.	
m.m. Pressure.	°C.	°C.	n_D.			
...	...	...	...	Dissolves with difficulty in hot water; likewise in cold alcohol and ether; warm alcohol and glacial acetic acid dissolve it readily. Insoluble in carbon bisulphide, chloroform, benzene, and petroleum ether		1
...	...	...	...	Readily soluble in ether and benzene		2
...	...	...	...	Sparingly soluble in hot water, ether, chloroform, and petroleum ether; readily soluble in alcohol		3
...	...	...	...	Very sparingly soluble in hot water; insoluble in cold water, ether, chloroform, carbon bisulphide, and benzene. Dissolves readily in hot alcohol and glacial acetic acid		4
...	...	...	...	More soluble in water than sativic acid. Insoluble in ether; sparingly soluble in alcohol		5
...	...	...	...	Sparingly soluble in cold water; readily soluble in hot water and hot alcohol. Insoluble in ether, benzene, carbon bisulphide and chloroform		6
0	152·5	...	...	Dissolves sparingly in cold water; 100 parts ether dissolve 0·809 parts at 15° C.; almost insoluble in chloroform		7
10	219·5					
15	230					
50	258·5					
100	279·0					
0	158	...	...	Sparingly soluble in cold water; 100 parts ether dissolve 2·68 parts at 15° C. Very easily soluble in alcohol		8
10	225·5					
15	237					
50	265					
100	286·5					
0	164	...	...	Sparingly soluble in cold water; readily soluble in alcohol and ether		9
10	232					
15	243·5					
50	273					
100	294·5					

TABLE No. 7.

		Formula.	Molecular Weight.	Specific Gravity.		Solidifying Point.
				°C.	–	°C.
	Alcohols, $C_nH_{2n+2}O$—					
1	Cetyl alcohol (Ethal) .	$C_{16}H_{34}O$	242	$\frac{49.6}{4}$	0·8176	...
				$\frac{99}{4}$	0·8105	...
				$\frac{79.7}{4}$	0·7984	
				$\frac{98.7}{4}$	0·7837	...
2	Octodecyl alcohol . .	$C_{18}H_{38}O$	207	$\frac{59}{4}$	0·8124	...
				$\frac{70}{4}$	0·8048	
				$\frac{99.1}{4}$	0·7849	
3	Carnaübyl alcohol . .	$C_{24}H_{50}O$	354	...	...	68-67
4	Ceryl alcohol . . .	$C_{26}H_{54}O$	382	...	...	...
5	Isoceryl alcohol . .	$C_{27}H_{56}O$	396	...	...	...
6	Myricyl (melissyl) alcohol .	$C_{30}H_{62}O$	438	...	...	...
	Alcohols, $C_nH_{2n}O$—					
7	Lanolin alcohol (?) . .	$C_{12}H_{24}O$	182	...	...	...
	Alcohols, $C_nH_{2n+2}O_2$—					
8	?	$C_{25}H_{52}O_2$	384	...	...	...
9	Cocceryl alcohol . .	$C_{30}H_{62}O_2$	454	...	...	...
10	Psyllostearyl alcohol . .	$C_{33}H_{68}O_2$	496	...	...	...
	Alcohols, $C_nH_{2n+2}O_3$—					
11	Glycerol	$C_3H_8O_3$	92	$\frac{15}{0}$	1·26358	...
				$\frac{15}{15}$	1·26468	...
				$\frac{17.5}{17.5}$	1·2620	...
				$\frac{20}{15}$	1·26348	
	Alcohols, $C_nH_{2n-8}O_2$—					
12	Cholesterol . . .	$C_{26}H_{44}O$	372	...	1·067	...
13	Isocholesterol . . .	$C_{26}H_{44}O$	372	...	...	...
14	Phytosterol . . .	$C_{26}H_{44}O$	372	...	...	...

—*Alcohols*

Melting Point.	Boiling Point.		Solubility.	Occurrence.	
°C.	m.m. Pressure.	°C.			
50	0	119	Dissolves in alcohol; easily soluble in ether and benzene	Spermaceti.	1
...	15	189·5			
...	760	344			
59	15	210·5	...	Spermaceti.	2
68-69	...	...	Soluble in alcohol	Wool wax.	3
79	...	...	Soluble in alcohol	Chinese wax.	4
62	...	...	Soluble in alcohol	Wool wax.	5
85; 88	...	...	Nearly insoluble in cold alcohol, easily soluble in hot alcohol	Bees wax.	6
102-104	...	...	Insoluble in ether, sparingly soluble in cold alcohol, chloroform, and benzene	Wool wax.	7
103·5—103·8	...	...	Dissolves sparingly in boiling petroleum ether; somewhat more readily in ether and in benzene	Carnaüba wax.	8
101-104	...	...	Dissolves in hot alcohol	Cochineal wax.	9
86-87	...	...	Almost insoluble in ether; sparingly soluble in petroleum ether; easily soluble in benzene		10
crystals melt at 20° C.	12·5	179·5	Miscible with alcohol and water; sparingly soluble in ether; insoluble in petroleum ether, chloroform, carbon bisulphide, and benzene	Constituent of all fats and fatty oils.	11
,,	50	210			
,,	760	290			
148·5	...	...	Insoluble in water; sparingly soluble in cold alcohol; easily soluble in ether, chloroform, carbon bisulphide, less readily in petroleum ether	Wool wax.	12
137-138	...	...	...	Wool wax.	13
132-134	...	...	...	Vegetable fats and oils.	14

TABLE No. 8.—*Freezing Mixtures*

Required per 100 parts of Snow, to produce	Temperature. °C.
13·5 parts potassium nitrate and 26 parts ammonium chloride .	−17·8
33 ,, sodium chloride	−21·3
52 ,, ammonium nitrate and 55 parts sodium nitrate . .	−25·8
9 ,, potassium nitrate and 67 parts ammonium rhodanate .	−28·2
13 ,, ammonium chloride and 37·5 parts sodium nitrate . .	−30·7
32 ,, potassium nitrate and 59 parts ammonium rhodanate .	−30·6
2 ,, potassium nitrate and 112 parts potassium rhodanate .	−34·1
39·5 ,, ammonium rhodanate and 54·5 parts sodium rhodanate .	−37·4
143 ,, crystallised calcium chloride ($CaCl_2+2H_2O$) . . .	−50·0

TABLE No. 9 *see page* 26.

TABLE No. 10.—*Iodine Values of Unsaturated Fatty Acids and of their Glycerides*

Fatty Acid.	Formula.	Iodine Value of Fatty Acids.	Iodine Value of		
			Monoglyceride.	Diglyceride.	Triglyceride.
Tiglic	$C_5H_8O_2$	254·00	145·98	198·43	225·44
	$C_{12}H_{22}O_2$	128·28	93·38	112·39	120·57
	$C_{14}H_{26}O_2$	112·39	84·67	100·00	106·42
Hypogæic, Physetoleic, Lycopodic	$C_{16}H_{30}O_2$	100·00	77·44	90·07	95·25
Asellic	$C_{17}H_{32}O_2$	94·78	74·27	85·81	90·50
Oleic, Elaïdic, Isooleic, Rapic	$C_{18}H_{34}O_2$	90·07	71·35	81·93	86·20
Dœglic, Jecoleic	$C_{19}H_{36}O_2$	85·81	68·65	78·39	82·29
Erucic, Brassidic, Isœrucic	$C_{22}H_{42}O_2$	75·15	61·65	69·40	72·43
Elæomargaric	$C_{17}H_{30}O_2$	190·98	149·41	172·79	182·29
Linolic, Tariric, Millet Oil	$C_{18}H_{32}O_2$	181·42	143·50	164·93	173·58
Linolenic, Isolinolenic, Jecoric	$C_{18}H_{30}O_2$	274·10	216·47	249·02	262·15
Isanic	$C_{14}H_{20}O_2$	461·82	345·57	409·67	436·67
Therapic	$C_{17}H_{26}O_2$	387·78	302·38	350·34	369·90
Ricinoleic, Ricinisoleic	$C_{18}H_{34}O_3$	85·23	68·28	77·91	81·76

TABLE No. 9.—*Saponification Values, Percentages of Insoluble*

	Glyceride of Acid.	Monoglyceride.					I
		Formula.	Molecular Weight.	Saponification Value.	Insoluble Fatty Acids.	Glycerol.	Formula.
1	Acetic . . .	$C_3H_5(OH)_2(O.C_2H_3O)$	134	428·7	0	68·65	$C_3H_5(OH)(O.C_2H_3O)_2$
2	Butyric . .	$C_3H_5(OH)_2(O.C_4H_7O)$	162	346·3	0	56·80	$C_3H_5(OH)(O.C_4H_7O)_2$
3	Valeric . . .	$C_3H_5(OH)_2(O.C_5H_9O)$	176	318·8	0	52·27	$C_3H_5(OH)(O.C_5H_9O)_2$
4	Caproic . .	$C_3H_5(OH)_2(O.C_6H_{11}O)$	190	295·3	0	48·42	$C_3H_5(OH)(O.C_6H_{11}O)_2$
5	Caprylic . .	$C_3H_5(OH)_2(O.C_8H_{15}O)$	218	257·3	...	42·20	$C_3H_5(OH)(O.C_8H_{15}O)_2$
6	Capric . . .	$C_3H_5(OH)_2(O.C_{10}H_{19}O)$	246	228·1	...	37·40	$C_3H_5(OH)(O.C_{10}H_{19}O)_2$
7	Lauric . . .	$C_3H_5(OH)_2(O.C_{12}H_{23}O)$	274	204·7	...	33·58	$C_3H_5(OH)(O.C_{12}H_{23}O)_2$
8	Myristic . .	$C_3H_5(OH)_2(O.C_{14}H_{27}O)$	302	185·8	75·50	30·46	$C_3H_5(OH)(O.C_{14}H_{27}O)_2$
9	Palmitic . .	$C_3H_5(OH)_2(O.C_{16}H_{31}O)$	330	170·0	77·58	27·88	$C_3H_5(OH)(O.C_{16}H_{31}O)_2$
10	Stearic . . .	$C_3H_5(OH)_2(O.C_{18}H_{35}O)$	358	156·7	79·33	25·70	$C_3H_5(OH)(O.C_{18}H_{35}O)_2$
11	Oleic . . .	$C_3H_5(OH)_2(O.C_{18}H_{33}O)$	356	157·6	79·22	25·85	$C_3H_5(OH)(O.C_{18}H_{33}O)_2$
12	Linolic . . .	$C_3H_5(OH)_2(O.C_{18}H_{31}O)$	354	158·5	79·10	25·99	$C_3H_5(OH)(O.C_{18}H_{33}O)_2$
13	Linolenic . .	$C_3H_5(OH)_2(O.C_{18}H_{29}O)$	352	159·9	78·98	26·14	$C_3H_5(OH)(O.C_{18}H_{29}O)_2$
14	Ricinoleic . .	$C_3H_5(OH)_2(O.C_{18}H_{33}O_2)$	372	150·9	80·12	24·74	$C_3H_5(OH)(O.C_{18}H_{33}O_2)_2$
15	Erucic . . .	$C_3H_5(OH)_2(O.C_{22}H_{41}O)$	412	136·2	82·04	22·33	$C_3H_5(OH)(O.C_{22}H_{41}O)_2$
16	Cerotic . .	$C_3H_5(OH)_2(O.C_{26}H_{51}O)$	470	119·3	84·26	19·58	$C_3H_5(OH)(O.C_{26}H_{51}O)_2$
17	Hydroxystearic .	$C_3H_5(OH)_2(O.C_{18}H_{35}O_2)$	374	150·0	80·20	24·60	$C_3H_5(OH)(O.C_{18}H_{35}O_2)_2$
18	Dihydroxystearic .	$C_3H_5(OH)_2(O.C_{18}H_{35}O_3)$	390	143·9	81·02	23·59	$C_3H_5(OH)(O.C_{18}H_{35}O_3)_2$
19	Trihydroxystearic	$C_3H_5(OH)_2(O.C_{18}H_{35}O_4)$	406	138·2	81·78	22·66	$C_3H_5(OH)(O.C_{18}H_{35}O_4)_2$
20	Sativic . . .	$C_3H_5(OH)_2(O.C_{18}H_{35}O_5)$	422	133·0	82·48	21·80	$C_3H_5(OH)(O.C_{18}H_{35}O_5)_2$
21	Linusic . .	$C_3H_5(OH)_2(O.C_{18}H_{35}O_7)$	454	123·6	83·70	20·26	$C_3H_5(OH)(O.C_{18}H_{35}O_7)_2$
22	Acid, $C_{17}H_{34}O_2$.	$C_3H_5(OH)_2(O.C_{17}H_{33}O)$	344	163·1	...	26·74	$C_3H_5(OH)(O.C_{17}H_{33}O)_2$
23	Acid, M. W. = 275	...	349	160·8	...	26·36	$C_3H_5(OH)(OR)_2(R=274$

Fatty Acids, and Yields of Glycerol from Mono-, Di-, and Tri-glycerides

GLYCERIDE.				TRIGLYCERIDE.				
Molecular Weight.	Insoluble Fatty Acids.	Saponification Value.	Glycerol.	Formula.	Molecular Weight.	Insoluble Fatty Acids.	Saponification Value.	Glycerol.	
176	0	637·6	52·27	$C_3H_5(O.C_2H_3O)_3$	218	0	772·0	42·20	1
232	0	483·7	39·66	$C_3H_5(O.C_4H_7O)_3$	302	0	557·3	30·46	2
260	0	431·5	35·38	$C_3H_5(O.C_5H_9O)_3$	344	0	489·2	26·74	3
288	0	389·6	31·94	$C_3H_5(O.C_6H_{11}O)_3$	384	0	436·1	23·96	4
344	...	326·2	26·74	$C_3H_5(O.C_8H_{15}O)_3$	470	...	358·1	19·58	5
400	...	280·5	23·00	$C_3H_5(O.C_{10}H_{19}O)_3$	552	...	303·7	16·67	6
456	...	246·1	20·18	$C_3H_5(O.C_{12}H_{23}O)_3$	638	...	263·8	14·42	7
512	89·05	219·1	17·97	$C_3H_5(O.C_{14}H_{27}O)_3$	722	94·75	233·1	12·74	8
568	90·15	197·6	16·20	$C_3H_5(O.C_{16}H_{31}O)_3$	806	95·29	208·8	11·42	9
624	91·02	179·8	14·74	$C_3H_5(O.C_{18}H_{35}O)_3$	890	95·73	189·1	10·34	10
620	90·95	181·0	14·84	$C_3H_5(O.C_{18}H_{33}O)_3$	884	95·70	190·4	10·41	11
616	90·90	182·1	14·93	$C_3H_5(O.C_{18}H_{33}O)_3$	878	95·67	191·7	10·48	12
612	90·83	183·3	15·03	$C_3H_5(O.C_{18}H_{29}O)_3$	872	95·63	193·0	10·55	13
652	91·43	172·1	14·11	$C_3H_5(O.C_{18}H_{33}O_2)_3$	932	95·93	180·6	9·87	14
732	92·35	153·3	12·57	$C_3H_5(O.C_{22}H_{41}O)_3$	1052	96·39	160·0	8·74	15
848	93·40	132·3	10·85	$C_3H_5(O.C_{26}H_{51}O)_3$	1226	96·90	137·3	7·50	16
656	91·47	171·1	14·03	$C_3H_5(O.C_{18}H_{35}O_2)_3$	938	95·95	179·4	9·81	17
688	91·87	163·1	13·37	$C_3H_5(O.C_{18}H_{35}O_3)_3$	986	96·15	170·7	9·33	18
720	92·23	155·9	12·78	$C_3H_5(O.C_{18}H_{35}O_4)_3$	1034	96·35	162·8	8·90	19
752	92·56	149·2	12·24	$C_3H_5(O.C_{18}H_{35}O_5)_3$	1082	96·50	155·0	8·51	20
816	93·15	137·5	11·28	$C_3H_5(O\cdot C_{18}H_{35}O_7)_3$	1178	96·77	142·4	7·81	21
596	...	188·3	15·44	$C_3H_5(O.C_{17}H_{33}O)_3$	...	...	...	10·85	22
606	...	185·2	15·18	$C_3H_5(OR)_3$(R=274)	...	...	...	10·66	23

TABLE NO. 11

Logarithms for the Quotient $\frac{0{\cdot}2}{\text{cc. Thiosulphate}}$

cc. Thiosulphate.	Log. $\frac{0{\cdot}2}{cc}$.	cc. Thiosulphate.	Log. $\frac{0{\cdot}2}{cc}$.
14·0	1549020	16·3	0888424
14·05	1533537	16·35	0875122
14·1	1518109	16·4	0861862
14·15	1502736	16·45	0848641
14·2	1487417	16·5	0835461
14·25	1472151	16·55	0822320
14·3	1456940	16·6	0809219
14·35	1441781	16·65	0796158
14·4	1426675	16·7	0783135
14·45	1411622	16·75	0770152
14·5	1396620	16·8	0757207
14·55	1381670	16·85	0744301
14·6	1366771	16·9	0731433
14·65	1351924	16·95	0718603
14·7	1337127	17·0	0705811
14·75	1322380	17·05	0693056
14·8	1307683	17·1	0680339
14·85	1293035	17·15	0667659
14·9	1278437	17·2	0655016
14·95	1263888	17·25	0642409
15·0	1249387	17·3	0629839
15·05	1234935	17·35	0617305
15·1	1220531	17·4	0604808
15·15	1206174	17·45	0592346
15·2	1191864	17·5	0579920
15·25	1177602	17·55	0567529
15·3	1163386	17·6	0555173
15·35	1149216	17·65	0542853
15·4	1135093	17·7	0530567
15·45	1121015	17·75	0518316
15·5	1106983	17·8	0506100
15·55	1092996	17·85	0493918
15·6	1079054	17·9	0481770
15·65	1065157	17·95	0469655
15·7	1051303	18·0	0457575
15·75	1037494	18·05	0445528
15·8	1023729	18·1	0433514
15·85	1010007	18·15	0421534
15·9	0996329	18·2	0409586
15·95	0982693	18·25	0397671
16·0	0969100	18·3	0385789
16·05	0955550	18·35	0373939
16·1	0942041	18·4	0362122
16·15	0928575	18·45	0350336
16·2	0915150	18·5	0338583
16·25	0901766		

TABLE No. 12.—*Saponification Values of Waxes*

Pure Waxes.	Formula.	Molecular Weight.	Saponification Value.	Iodine Value.
Cetyl Palmitate, Cetin . .	$C_{16}H_{33}.O.CO.C_{15}H_{31}$	480	116·9	0
Octodecyl Palmitate . .	$C_{18}H_{37}.O.CO.C_{15}H_{31}$	508	110·4	0
Ceryl Palmitate . . .	$C_{26}H_{53}.O.CO.C_{15}H_{31}$	620	90·5	0
Myricyl Palmitate, Myricin .	$C_{30}H_{61}.O.CO.C_{15}H_{31}$	676	83·0	0
Cetyl Stearate	$C_{16}H_{33}.O.CO.C_{17}H_{35}$	508	110·4	0
Ceryl Cerotate	$C_{26}H_{53}.O.CO.C_{25}H_{53}$	762	73·6	0
Cocceryl Coccerate, Coccerin .	$C_{30}H_{60}.(O.C_{31}H_{61}O_2)_2$	1382	81·2	?
Cholesteryl Palmitate . .	$C_{26}H_{43}.O.CO.C_{15}H_{31}$	610	92·0	41·63
Cholesteryl Oleate . . .	$C_{26}H_{43}.O.CO.C_{17}H_{33}$	636	88·2	79·87
Cholesteryl Stearate . .	$C_{26}H_{43}.O.CO.C_{17}H_{35}$	638	87·9	39·81
Isocholesteryl Stearate . .	$C_{26}H_{43}.O.CO.C_{17}H_{35}$	638	87·9	39·81
Cholesteryl Cerotate . .	$C_{26}H_{43}.O.CO.C_{26}H_{53}$	764	73·4	33·87

TABLE No. 13.—*Acetylated Glycerides. Saponification Values, Percentages*

	Glyceride of Acid.	Acetylated Monoglyceride.					Acetylated
		Formula.	Molecular Weight.	Saponification Value.	Insoluble Fatty Acids.	Acetyl Value.	Formula.
1	Acetic . . .	$C_3H_5(O.C_2H_3O)_2(O.C_2H_3O)$	218	772·0	...	772·0	$C_3H_5(O.C_2H_3O)(O.C_2H_3O)_2$
2	Butyric . .	$C_3H_5(O.C_2H_3O)_2(O.C_4H_7O)$	246	684·2	...	684·2	$C_3H_5(O.C_2H_3O)(O.C_4H_7O)_2$
3	Valeric . .	$C_3H_5(O.C_2H_3O)_2(O.C_5H_9O)$	260	647·3	...	...	$C_3H_5(O.C_2H_3O)(O.C_5H_9O)_2$
4	Caproic . .	$C_3H_5(O.C_2H_3O)_2(O.C_6H_{11}O)$	274	614·2	...	...	$C_3H_5(O.C_2H_3O)(O.C_6H_{11}O)_2$
5	Caprylic . .	$C_3H_5(O.C_2H_3O)_2(O.C_8H_{15}O)$	302	557·3	...	...	$C_3H_5(O.C_2H_3O)(O.C_8H_{15}O)_2$
6	Capric . .	$C_3H_5(O.C_2H_3O)_2(O.C_{10}H_{19}O)$	330	510·0	...	...	$C_3H_5(O.C_2H_3O)(O.C_{10}H_{19}O)_2$
7	Lauric . .	$C_3H_5(O.C_2H_3O)_2(O.C_{12}H_{23}O)$	358	470·1	...	...	$C_3H_5(O.C_2H_3O)(O.C_{12}H_{23}O)_2$
8	Myristic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{14}H_{27}O)$	386	436·0	59·06	290·7	$C_3H_5(O.C_2H_3O)(O.C_{14}H_{27}O)_2$
9	Palmitic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{16}H_{31}O)$	414	406·6	61·83	271·0	$C_3H_5(O.C_2H_3O)(O.C_{16}H_{31}O)_2$
10	Stearic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{18}H_{35}O)$	442	380·8	64·26	253·9	$C_3H_5(O.C_2H_3O)(O.C_{18}H_{35}O)_2$
11	Oleic . . .	$C_3H_5(O.C_2H_3O)_2(O.C_{18}H_{33}O)$	440	382·4	64·07	255·0	$C_3H_5(O.C_2H_3O)(O.C_{18}H_{33}O)_2$
12	Linolic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{18}H_{31}O)$	438	384·3	63·93	256·2	$C_3H_5(O.C_2H_3O)(O.C_{18}H_{31}O_1)_2$
13	Linolenic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{18}H_{29}O)$	436	386·0	63·76	257·3	$C_3H_5(O.C_2H_3O)(O.C_{18}H_{29}O)_2$
14	Ricinoleic . .	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{32}O(O.C_2H_3O)]$	498	450·0	59·84	338·0	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{32}O(O.C_2H_3O)]_2$
15	Erucic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{22}H_{41}O)$	496	339·3	68·14	226·2	$C_3H_5(O.C_2H_3O)(O.C_{22}H_{41}O)_2$
16	Cerotic . .	$C_3H_5(O.C_2H_3O)_2(O.C_{26}H_{51}O)$	554	303·8	71·49	202·5	$C_3H_5(O.C_2H_3O)(O.C_{26}H_{51}O)_2$
17	Hydroxystearic .	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{34}O(O.C_2H_3O)]$	500	448·7	60·0	336·7	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{34}O(O.C_2H_3O)]_2$
18	Dihydroxystearic	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{33}O(O.C_2H_3O)_2]$	558	502·8	56·64	402·2	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{33}O(O.C_2H_3O)_2]_2$
19	Trihydroxystearic	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{32}(O.C_2H_3O_3)]$	616	546·4	53·89	455·4	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{32}O(O.C_2H_3O)_3]_2$
20	Sativic . .	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{31}O(O.C_2H_3O)_4]$	674	582·7	51·63	499·3	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{31}O(O.C_2H_3O)_4]_2$
21	Linusic . .	$C_3H_5(O.C_2H_3O)_2[O.C_{18}H_{29}O(O.C_2H_5O)_6]$	790	639·2	48·11	56·82	$C_3H_5(O.C_2H_3O)[O.C_{18}H_{29}O(O.C_2H_3O)_6]_2$
22	$C_{17}H_{34}O_2$ . .	$C_3H_5(O.C_2H_3O)_2[O.C_{17}H_{33}O]$	428	393·3	63·10	26·22	$C_3H_5(O.C_2H_3O)[O.C_{17}H_{33}O]_2$
23	Acid Mol. W. 275	...	433	388·6	63·5	259·1	...

soluble Fatty Acids, and Acetyl Values of Mono-, Di-, and Tri-glycerides

GLYCERIDE.				ACETYLATED TRIGLYCERIDE.					
olecular Weight.	Saponification Value.	Insoluble Fatty Acids.	Acetyl Value.	Formula.	Molecular Weight.	Saponification Value.	Insoluble Fatty Acids.	Acetyl Value.	
218	772·0	...	772·0	...	...	...	...	0	1
274	614·2	...	...	...	...	....	...	0	2
302	557·3	...	...	...	...	...	...	0	3
330	510·0	...	...	...	...	...	...	0	4
386	436·0	...	...	...	...	...	...	0	5
442	380·8	...	...	...	...	...	...	0	6
498	338·0	...	...	...	...	...	...	0	7
554	303·8	82·30	101·3	...	...	...	...	0	8
610	276·0	83·92	91·99	...	...	...	...	0	9
666	252·7	85·28	84·24	...	...	...	...	0	10
662	254·3	85·18	84·74	...	...	...	...	0	11
658	255·8	85·12	85·28	...	...	...	...	0	12
654	257·4	85·00	85·78	...	...	...	...	0	13
778	360·6	76·60	216·3	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)]_3$	1058	318·2	84·49	159·1	14
774	217·5	87·34	72·5	...	...	...	...	0	15
890	189·1	88·80	63·05	...	...	...	...	0	16
782	358·7	76·72	215·3	$C_3H_5[O.C_{18}H_{34}O(O.C_2H_3O)]_3$	1064	316·3	84·56	158·1	17
898	43·73	70·37	312·4	$C_3H_5[O.C_{18}H_{33}O(O.C_2H_3O)_2]_3$	1238	407·8	76·67	271·9	18
014	498·0	65·48	387·4	$C_3H_5[O.C_{18}H_{32}O(O.C_2H_3O)_3]_3$	1412	476·8	70·54	357·6	19
130	546·1	61·59	446·8	$C_3H_5[O\cdot C_{18}H_{31}O(O.C_2H_3O)_4]_3$	1586	530·5	65·81	424·3	20
362	611·0	55·81	535·5	$C_3H_5[O.C_{18}H_{29}O(O.C_2H_3O)_6]_3$	1934	609·2	58·94	522·1	21
638	263·8	84·66	87·95	...	...	...	...	0	22
648	259·7	84·80	86·5	...	...	...	...	0	23

TABLE No. 14.—*Acetyl Values of Alcohols.*

Alcohol.	Acetate of Alcohol.			Acetyl Value.
	Formula.	Molecular Weight.	Saponification Value.	
Cetyl alcohol .	$C_{16}H_{33}O.C_2H_3O$	284	197·6	197·6
Ceryl alcohol .	$C_{26}H_{53}O.C_2H_3O$	424	132·3	132·3
Myricyl alcohol	$C_{30}H_{61}O.C_2H_3O$	480	116·9	116·9
Glycerol . .	$C_3H_5(O.C_2H_3O)_3$	218	772·0	772·0
Cholesterol .	$C_{26}H_{43}O.C_2H_3O$	414	135·5	135·5

TABLE No. 15.—*Acid Values of Fatty Acids.*

Acid.	Formula.	Molecular Weight.	Acid Value.
Acetic . . .	$C_2H_4O_2$	60	935·0
Butyric . .	$C_4H_8O_2$	88	637·5
Caproic . .	$C_6H_{12}O_2$	116	483·6
Caprylic . .	$C_8H_{16}O_2$	144	389·6
Capric . . .	$C_{10}H_{20}O_2$	172	326·2
Lauric . . .	$C_{12}H_{24}O_2$	200	280·5
Myristic . .	$C_{14}H_{28}O_2$	228	246·1
Palmitic . .	$C_{16}H_{32}O_2$	256	219·1
Stearic . .	$C_{18}H_{36}O_2$	284	197·5
Oleic . . .	$C_{18}H_{34}O_2$	282	198·9
Linolic . .	$C_{18}H_{32}O_2$	280	200·4
Linolenic . .	$C_{18}H_{30}O_2$	278	198·2
Ricinoleic . .	$C_{18}H_{34}O_3$	298	188·3
Arachidic . .	$C_{20}H_{40}O_2$	312	179·8
Erucic . . .	$C_{22}H_{42}O_2$	338	166·0
Cerotic . .	$C_{26}H_{52}O_2$	396	141·7
Hydroxystearic .	$C_{18}H_{36}O_3$	300	187·0
Dihydroxystearic	$C_{18}H_{36}O_4$	316	177·6
Trihydroxystearic	$C_{18}H_{36}O_5$	332	169·0
Sativic . .	$C_{18}H_{36}O_6$	348	161·2
Linusic . .	$C_{18}H_{36}O_8$	380	147·6

TABLE No. 16

Conversion of Acid Value into Oleic Acid

Acid Value.	Oleic Acid. Per cent.
1	0·5027
2	1·0054
3	1·5081
4	2·0108
5	2·5135
6	3·0162
7	3·5189
8	4·0216
9	4·5243

TABLE No. 17

Some Unsaponifiable Substances and their Constants

	Formula.	Melting Point. °C.	Iodine Absorption.	Acetates.		Increase in Weight on Boiling with Acetic Anhydride.
				Saponification Value.	Melting Point. °C.	Per cent.
Paraffin wax, Ceresine	...	38-82	3·9-4·0	...	...	0
Cetyl alcohol . .	$C_{16}H_{34}O$	50	0	197·5	22-23	17·2
Octodecyl alcohol .	$C_{18}H_{38}O$	59	0	180·0	31	15·5
Ceryl alcohol . .	$C_{27}H_{56}O$	79	0	128·1	65	10·6
Myricyl alcohol .	$C_{30}H_{62}O$	85	0	116·7	70	9·6
Cholesterol . .	$C_{26}H_{44}O$	148·5	68·3	135·5	92	11·3
Isocholesterol . .	$C_{26}H_{44}O$	137-138	68·3	135·5	below 100	11·3
Phytosterol . .	$C_{26}H_{44}O$	137-138	68·3	135·5	...	11·3
Mixed alcohols from sperm oil	?	25·5-27·5	64·6-65·8	161-190		
Mixed alcohols from neutral wool fat	?	...	36	160·9		
Mixed alcohols from crude wool fat	?	...	...	150·6		
Mixed alcohols from beeswax	?	75-76	...	99-103	...	6·5-7·7
Mixed alcohols from carnaüba wax	?	85	...	123	...	10·21

TABLE No. 18.—*Elaïdin Test*

Description of Mass.	Yielded by
(1) Solid, hard	Olive oil, Almond oil, Arachis oil, Lard oil, Sperm oil, (Neat's foot oil).
(2) Butter-like	Neat's foot oil, Arctic sperm oil, Mustard seed oil, (Arachis, Sperm, and Rape Oils).
(3) Pasty or buttery, separating from a fluid portion . . .	Rape oil, Sesamé oil, Cotton seed oil, Sunflower oil, Niger seed oil, Cod liver oil, Seal oil, Whale oil, Porpoise oil.
(4) Liquid products . . .	Linseed oil, Hemp seed oil, Walnut oil, Drying oils generally.

TABLE No. 19.—*Sulphur Chloride Test*

Oils and Fats treated with S_2Cl_2; 5 grms. of fat with 2 c.c. S_2Cl_2, and 2 c.c. CS_2 (Lewkowitsch).

A. *Product completely soluble in Carbon Bisulphide*

Class of Oil.	Kind of Oil or Fat.	Mass thickens after Minutes.
Liquid waxes	Sperm oil, No. 1	20
	Sperm oil, No. 2	45
	Arctic sperm oil, No. 1	45
	Arctic sperm oil, No. 2	55
	Arctic sperm oil, No. 3	30
Vegetable fats	Palm oil	Does not thicken.
	Palm nut oil	
	Cocoa nut oil	
	Mowrah seed oil	
Animal fats	Beef tallow	
	Mutton tallow	
	Lard	
	Butter fat	

B. *Product not completely soluble in Carbon Bisulphide*

Class of Oil.	Kind of Oil.	Solidifies after Minutes.		Soluble in CS_2.
		In the Cold.	On the Water-bath.	Per cent.
Drying oils	Linseed oil	10	2	14·4
	Hemp seed oil	11	...	9·2
	Poppy seed oil	21	...	10·6
Fish oils	Japan fish oil	9	...	12·4
Liver oils	Cod liver, fresh	15	...	4·4
	Cod liver, rancid	1½	...	6·4
Blubber oils	Seal oil	11	...	4·4
	Whale oil	13	...	3·0
Semi-drying oils	Cotton seed oil	20	4	24·0
	Sesamé oil	21	...	18·4
	Colza oil	23	...	2·8
	Rape oil	12	2	4·2
	Croton oil	18	...	25·4
	Castor oil	½	at once	3·8
Non-drying oils	Peach oil	26	...	4·8
	Almond oil, sweet	27	...	4·0
	Almond oil, bitter	28	...	3·4
	Arachis oil	30	...	6·0
	Olive oil	22	4	4·2
	Sheep's foot oil	36	...	6·0
	Horses' foot oil	20	...	13·6
	Neat's foot oil	23	...	9·4
	Lard oil	10	...	15·0
	Tallow oil	12	...	29·8

TABLE NO. 20.—*Oxygen Absorption by Livache's Test*

Kind of Oil.	Gain in Weight of 100 parts		
	Of Oil after		Of Fatty Acids after
	Two days.	Seven days.	Eight days.
Linseed oil	14·3	...	11·0
Stillingia oil	8·72	12·45 (8 days)	
Walnut oil	7·9	...	6·0
Poppy seed oil	6·8	...	3·7
Cotton seed oil	5·9	...	0·8
Beechnut oil	4·3	...	2·6
Colza oil	0·0	2·9	2·6
Rape oil	0·0	2·9	0·9
Sesamé oil	0·0	2·4	2·0
Arachis oil	0·0	1·8	1·3
Olive oil	0·0	1·7	0·7

TABLE No. 21

Oxygen Absorption by Bishop's Test

(Oils mixed with 2 per cent Manganese Resinate and spread over precipitated silica)[1]

Oils.	Specific Gravity.	Absorption of Oxygen in Per Cent. "Degrees of Oxidation."	Mean Values.
Linseed oil, French	0·9327	17·70-16·40	17·05
,, ,, La Plata	0·9304	15·45-15·00	15·20
Hemp seed oil	0·9287	14·55-14·30	14·40
Poppy seed oil, French	0·924	14·50-13·90	14·20
Walnut oil, French	0·924	13·70	13·70
Cotton seed oil	0·924	8·60	8·60
,, ,, without stearine	0·923	9·60-9·30	9·45
Sesamé oil, Senegal	0·9215	8·95-8·50	8·70
,, ,, Indian	0·921	7·40	7·40
Arachis oil, African	0·916	6·70	6·70
,, ,, white	0·916	6·50	6·50
Colza oil, French	0·9142	6·40 (?)	6·40 (?)
,, ,, Indian	0·9137	5·90-5·80 (?)	5·85 (?)
Olive oil	0·9155	5·30 (?)	5·30 (?)

[1] Cp. Oxidised Oils, Part II.

TABLE NO. 22

Hydroxylated Acids obtained on oxidising unsaturated Fatty Acids

Acid.	Formula.	Melting Point °C.	Solubility of the						
			Acids in					Barium Salts in	
			Water.		Alcohol.		Ether.	Water.	
			Cold.	Hot.	Cold.	Hot.		Cold.	Hot.
Dihydroxystearic .	$C_{18}H_{34}O_2(OH)_2$	137	Insoluble	Insoluble	Sparingly soluble	Soluble	Sparingly soluble	Insoluble	Insoluble
Sativic . . .	$C_{18}H_{32}O_2(OH)_4$	173	Insoluble	Sparingly soluble	Sparingly soluble	Soluble	Insoluble	Insoluble	Insoluble
Linusic . . .	$C_{18}H_{30}O_2(OH)_6$	203–205	Sparingly soluble	Soluble	Sparingly soluble	Sparingly soluble	Insoluble	Sparingly soluble	Readily soluble
Isolinusic . .	$C_{18}H_{30}O_2(OH)_6$	173–175	Sparingly soluble	Readily soluble	Soluble	Soluble	Insoluble	Sparingly soluble	Readily soluble

TABLE No. 23—*Bromoderivatives of Unsaturated Fatty Acids*

Bromoderivative from	Name of Acid.	Formula.	Molecular Weight.	Melting Point.	Containing Bromine.	Solubility in					
				°C.	Per cent.	Alcohol.	Ether.	Chloroform.	Petroleum Ether.	Benzene.	Glacial Acetic Acid.
Oleic acid .	Dibromostearic Oleic dibromide	$C_{18}H_{34}O_2Br_2$	442	Oil	36·18	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble	Readily soluble
Elaïdic acid .	Dibromoelaïdic Elaïdic dibromide	$C_{18}H_{34}O_2Br_2$	442	27	36·18						
Linolic acid .	Tetrabromostearic Linolic tetrabromide	$C_{18}H_{32}O_2Br_4$	600	113-114	53·33	Easily soluble	Easily soluble	Easily soluble	*Sparingly soluble*	Easily soluble	Easily soluble
Tariric acid .	Tariric tetrabromide	$C_{18}H_{32}O_2Br_4$	600	125	53·33						
Telfairic acid .	Telfairic tetrabromide	$C_{18}H_{32}O_2Br_4$	600	57-58	53·33	Easily soluble					
Linolenic acid .	Hexabromostearic Linolenic hexabromide	$C_{18}H_{30}O_2Br_6$ ...	758 ...	177 180-181	63·32	Very sparingly soluble	Very sparingly soluble	...	Almost insoluble	Soluble	Very sparingly soluble
Therapic acid .	(Octobromo-heptadecylic acid ?) Therapic octobromide	$C_{17}H_{26}O_2Br_8$	902	...	70·95	Almost insoluble	Almost insoluble	Almost insoluble	...	Almost insoluble	Almost insoluble
Hydroxy acid in Quince oil .	...	$C_{18}H_{34}O_3Br_2$	458	108	34·91	...	...	...	Soluble		
Ricinoleic . .	Dibromoricinoleic Ricinoleic dibromide	$C_{18}H_{34}O_3Br_2$	458	Oil	34·91	Soluble	Easily soluble				
Ricinelaïdic .	Dibromoricinelaïdic Ricinelaïdic dibromide	$C_{18}H_{34}O_3Br_2$	458	Oil	34·91						

PART II

FATS, OILS, AND WAXES, AND THE COMMERCIAL PRODUCTS DERIVED THEREFROM

A. FATS, OILS, WAXES, AND THEIR CONSTANTS AND VARIABLES

THE Tables No. 24 contain a list of all known fats, oils, and waxes arranged within the classifications given in Part I. A, according to the magnitude of their iodine values. It may, however, be pointed out that it has not been considered advisable to slavishly follow this principle, and such oils and fats as are undoubtedly related to one another have, therefore, been placed together regardless of the iodine numbers.

The figures given comprise the constants of fats and oils on the one hand, and of the mixed fatty acids on the other. Between the two are placed numbers obtained for the variables.

In the case of waxes there have further been added constants for the alcohols (+ unsaponifiable) contained in the waxes.

In many instances the limits between which the experimental numbers lie have been given; in others I had to decide on the mean figures or on the most probable ones.

TABLE NO. 24 A.—

DRYING OILS.										CON-
Name of Oil.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	Insoluble Fatty Acids + Unsaponifiable (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.	
			Per cent.	°C.		°C.	°C.	Per cent.	c.c. ½ norm. KOH.	
Linseed	Linum usitatissimum	The East	38-40	15	0·9315-0·9345	- 27	- 20	95·5	...	
Tung oil, Chinese (Japanese) wood oil	Aleurites cordata (Elæococca vernicia)	China and Japan	40-41	15	0·9360-0·9432	below - 17	...	96·2	...	
Lallemantia	Lallemantia iberica	Caucasus, Russia	29-30	20	0·9336	- 35	...	93·3	1·55 (R.)	
Candle nut	Aleurites moluccana	South Sea Islands	62-64	15·5	0·9256	...	liquidate - 18	95·5	...	
Stillingia	Stillingia sebifera	China	19	15	0·9432	...	...	94·4	0.93 (R. M.)	
Cedar nut	Pinus cembra	Alps, Siberia	...	15	0·930	...	...	92·6	...	
Garden rocket	Hesperis matronalis	Southern Europe	28-30	15	0·9335	- 22 to - 23	...	...	...	
Hemp seed	Cannabis sativa	Asia	30-35	15	0·9255-0·9280	- 27	...	...	...	
Walnut, Nut	Juglans regia	Persia, Himalaya	63-65	15·0	0·9250-0·9260	- 27·5	...	95·4	...	
Safflower	Carthamus tinctorius	Egypt, India	30-32	15·5	0·9251-0·9280	...	...	95·37	1·54 (R. M.)	
Poppy seed	Papaver somniferum	Asia Minor	41-50	15·0	0·9240-0·9270	- 18	...	95·2	0·0	
Henbane	Hyoscyamus niger	Europe	35-37	15	0·939	...	...	94·7	0·99 (R.)	
Amoora	Amoora rohituka	India	...	15·5	0·9386	...	...	93·23	1·64 (R. M.)	
Niger seed	Guizotia oleifera	Abyssinia, India	40-45	15·5	0·9248-0·9270	- 9	...	94·1	0·11-0·63 (R. M.)	
Sunflower	Helianthus annuus	Mexico, Peru	21-22	15·0	0·9240-0·9258	- 18·5	...	95·0	...	
Celosia	Celosia cristata	East India, China	...	...	...	- 10° C.	...	...	...	
Argemone	Argemone mexicana	East and West Indies	...	15·5	0·9247-0·9259	...	...	95·07	...	
Fir seed	Pinus sylvestris	Europe	32	15	0·9312	- 27 to - 30				
Fir seed	Pinus Picea	Europe	32-33	15	0·9215-0·9250	- 18 to - 20	...	...	...	
Madia	Madia sativa	Chili	32-33	15	0·9285	- 12 to - 15	...	...	...	
Indian laurel	Laurus indica	...	...	15	0·926	below - 15	...	...	...	
Tobacco seed	Nicotiana tabacum	America	38-40	15	0·9232	- 25				
Weld seed	Reseda luteola	Europe	30-32	15	0·9058	- 20				
Isano (Ungueko)	...	French Congo	60	23	0·973	below - 15	...	...	...	
Mohamba	...	French Congo	12	...	0·915	below - 15	...	...	...	

Sapo

TABLE No. 24 A—*con.*

NON-DRYING OILS.

	Name of Oil.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	Insoluble Fatty Acids + Unsaponifiable (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.
				Per cent.	°C.		°C.	°C.	Per cent.	c.c. $\frac{1}{10}$ norm. KOH.
1	Quince . . .	Cydonia vulgaris	Asia	...	15	0·9220	...	...	95·2	0·5 (R. M.
2	Cherry kernel	Prunus cerasus	Europe	35-36	15	0·9234	– 19 to – 20	...	...	...
3	Cherry laurel .	Prunus laurocerasus	Caucasus	...	15	0·9230	– 19 to – 20	...	...	...
4	Apricot kernel	Prunus Armeniaca	Asia	40-45	15·5	0·9195	– 14	...	95·4	0·0
5	Plum kernel .	Prunus domestica	Europe	25-30	15	0·9160-0·9195	– 5 to – 6	...	...	...
6	Peach kernel .	Prunus persica	Persia	32-35	15	0·918-0·9215	below – 20	...	...	...
7	Wheat meal .	Triticum vulgare	West Asia	...	100	0·9068	...	...	...	2·8 (R.M.)
8	Acorn . . .	Quercus agrifolia	...	...	15	0·9162	10	...	...	...
9	Almond . . .	Prunus amygdalus	Mediterranean	45-55	15	0·9175-0·9195	– 10 to – 20	...	96·2	
10	Sanguinella (Dogwood)	Cornus sanguinea	Europe	17-20	15	0·9210	– 15	...	...	...
11	Californian nutmeg	Tumion californicum	California	...	15	0·9072	...	...	...	...
12	Arachis . . .	Arachis hypogaea	W. Africa, India	43-45	15	0·9170-0·9209	– 3 to 0	0	95·8	..
13	Rice	Oryza sativa	East India	8-15	...	...	...	...	...	...
14	Tea seed (Chinese)	Camellia theifera	China	30-35	15	0·917-0·927	– 5	...	...	...
15	Tea seed (Assam)	Camellia oleifera	China	43-45	15	0·9200	– 12	...	91·5	...
16	Pistachio . .	Pistacia vera, P. lentiscus	Southern Europe	...	15	0·9185	– 8 to – 10	...	...	...
17	Hazel nut . .	Corylus avellana	Europe	50-60	15	0·9146-0·9170	– 17	...	95·6	0·99 (R. M.
18	Koëme . . .	Telfairia pedata	S. E. Africa	33	15	0·9180	+ 7	...	...	...
19	Birch seed . .	Betula alba	...	...	...	...	...	...	...	...
20	Louc-Mouc seed	...	...	...	...	...	...	...	...	...
21	Olive . . .	Olea europæa	Southern Europe	40-60	15	0·916-0·918	– 6 to + 2	...	95	0·3
22	Olive kernel .	Olea europæa	Southern Europe	12-15	15	0·9184-0·9191	...	...	...	...
23	Coffee berry .	Coffea arabica	E. Africa	...	15	0·9510-0·9525	6 – 3	...	...	1·7 (R. M.)
24	Ungnadia . .	Ungnadia speciosa	Texas	46-50	15	0·9120	– 12	...	94·12	...
25	Ben	Moringa oleifera	Egypt, India	35-36	15	0·9120-0·9198	0	...	...	...
26	Strophantus seed	Strophantus hispidus	...	...	13	0·9254	...	...	95·3	0·5 (R. M.
27	Tropæolum .	Tropæolum majus	S. America	46-50	...	...	...	...	...	...
28	Paradise nut .	Lecythis zabucaja	Brazil, Guyana	40-42	15	0·8950	4	...	...	...
29	Secale . . .	Secale cornutum	...	...	13	0·9254	...	...	96·3	...

TABLE NO. 24

	Name of Oil.	Source.	Native Country.	Specific Gravity. °C.	Specific Gravity.	Solidifying Point. °C.	Melting Point. °C.	Insoluble Fatty Acids + Unsaponifiable (Hehner Value). Per cent.	Reic (R. Reic Me (R, Va c.c no KC
	MARINE ANIMAL OILS								
1	Menhaden . .	Alosa menhaden	West Coast of North America	15·5	0·927-0·933	−4	...	...	1
2	Sardine . . .	Clupea sardinus	Mediterranean	15	0·9330	...	...	94·5	
3	Japanese sardine (Japan fish)	Clupea sardinus (?)	Japan	15	0·9160	...	20 – 22	96-97	
4	Herring . . .	Clupea harengus	Northern Europe	15·5	0·9202-0·939	...	...	95·64	
5	Stickleback . .	Gasterosterus trachurus	Europe	...	...	...	...	95·78	
6	Sturgeon . . .	Accipenser sturio	Black Sea, Caspian Sea	15	0·9236	...	...	...	
7	Sprat	Clupea sprattus	North Sea, Baltic	15·5	0·9284				
8	Cod liver . . .	Gadus morrhua	Northern Atlantic	15	0·9210-0·9270	0 to −10	...	95·3	
9	Haddock liver .	Merluccius œglefinus	North Sea	15	0·9298	...	...	93·3	
0	Skate liver . .	...	...	15	0·9307	...	...	94·7	
1	Tunny fish . .	Thynnus vulgaris	Mediterranean	...	...	...	...	95·79	
2	Shark liver (Arctic)	Scymnus borealis	Northern Atlantic	15	0·9163	...	...	86·9	
3	Coal fish liver .	Gadus merlangus (virens)	North Sea, Baltic	15	0·925	...	...	...	
4	Hake liver . .	Merluccius communis	North Sea	15·5	0·9270				
5	Ray liver . . .	Raja clavata (batis)	Coasts of Europe	15·5	0·9280				
6	Ling liver . . .	Molva vulgaris	North Sea	15	0·9200	...	...	...	
7	Seal	Phoca vitulina	Greenland, White Sea	15	0·9155-0·9263	−2 to −3	...	95·45	0·0 0
8	Whale	Balæna mysticetus	Arctic Seas	15·5	0·9250	below −2	...	93·5	0·7
9	Dolphin (Black fish) body oil	Delphinus globiceps [ceps	Northern Seas	15	0·9180	below −3	...	93·07	5
0	Dolphin jaw oil .	Delphinus globi-	...	...	...	...	...	66·28	65
	Porpoise body oil	Delphinus phocæna	North Atlantic	15	0·9258	−16	...	...	23
	Porpoise jaw oil	Delphinus phocæna	,,	15	0·9258	...	...	70·23	47·7 65·
	Cramp fish . .	...	America	15	0·909	...	...	...	...
	Sunfish oil . .	...	America	15	0·901	...	...	...	...
	TERRESTRIAL ANIMAL OILS								
	Sheep's foot . .	Ovis aries	...	15	0·9175	0 to 15	...	...	...
	Horses' foot . .	Equus caballus	...	15	0·913-0·927	...	...	...	...
	Egg	Gallus domesticus	...	15	0·9144	8 – 10	22·25	95·16	0·40- (R.M
	Neat's foot . .	Bos taurus	...	15	0·914-0·916	0-1·5	...	...	...

TABLE No. 24 C

	Vegetable Fats.									
	Name of Fat.	Source.	Native Country.	Yield from Seed or Fruit.	Specific Gravity.		Solidifying Point.	Melting Point.	Insoluble Fatty Acids + Unsaponifiable (Hehner Value).	Rei (R. Rei Mo (R. Va
				Per cent.	°C.		°C.	°C.	Per cent.	c.c. nor KO
1	Cottonseed Stearine	Gossypium herbaceum	Asia, Africa, America	6-8	15	0·9188-0·9230	16-22	29-32	95·9	...
2	Chaulmoogra .	Gynocardia Prainii	India	40-45	...	...	...	...	...	...
3	Laurel . . .	Laurus nobilis, *L.*	S. Europe	24-26	15	0·9332	25	32-34	...	1·6
4	Carapa (crab-wood)	Carapa guianensis (C. moluccensis)	Brazil, Indies	40-50	15·5	0·9225	36	31	93·7	2·2 (R.
5	Mahua butter	Bassia latifolia	India	50-55	100 (100° C. = 1)	0·8981	19-22	28-31	94·82	0·5-0 (R.
6	Mowrah seed (M. butter)	Bassia longifolia	India	50-55	15	0·9175	36	42	94·76	...
7	Shea butter (Galam butter)	Bassia Parkii	W. Africa	49-52	15	0·9175	17-18	25·3	94·76	...
8	Palm oil . .	Elæis guineensis, E. melanococca	W. Africa, S. America	65-72	15	0·921-0·9245	...	27-42·5	94·97	0·5
9	Vegetable tallow (of China)	Stillingia sebifera (Croton sebiferum)	China, Punjab	22	15	0·9180	27-31	36-46	...	...
10	Akee oil . .	Blighia sapida	W. Africa	...	99-100	0·857	20	25-35	93	0·9 (R.M
11	Macassar . .	Schleicheria trijuga	E. India	70	15	0·9240	10	22	91·5	...
12	Sawarri . .	Caryocar tomentosum	S. America	60	40 (15 = 1)	0·8981	29-23·3	29·5-35·5	96·9	0·65
13	Mafura tallow	Mafureira oleifera (Trichilia emetica)	Mozambique	49	...	...	37-30	35-42	93	0·9
14	Nutmeg butter (mace butter)	Myristica officinalis	Molucca	38-40	15	0·945-0·996	41-42	38-51	...	1·4·2 (R.M
15	Phulwara butter	Bassia butyracea	Himalaya	50-52	100	0·8970	...	39	94·86	0·44 (R.M
16	Mkanyi . .	Stearodendron Stuhlmanni	E. Africa	67	15	0·9298	38	40-41	95·65	1·21 (R.M
17	Rambutan tallow	Nephelium lappaceum	China, Sunda Islands	40-45	...	0·9236	38-39	42-46	...	...
18	Malabar tallow	Vateria indica	E. Indies	49	15	0·9150	30·5	36·5	0·2-0·44 (R.M.)	...
19	Cacao butter (cocoa butter)	Theobroma cacao	Central America	44-50	15	0·9500-0·976	23-21·5	28-33	94·59	0·2-0·((R.M.
20	Kokum butter (Goa butter)	Garcinia indica	E. Indies	20-25	40 (15° = 1)	0·8952	37·6-37·9	41-42	95·1	0·1-1·((R.M.
21	Borneo tallow	Shorea stenoptera, Hopea aspera	Sunda Islands	45-50	...	...	...	35-42	...	...
22	Dika oil (oba oil, wild mango oil)	Irvingia gabonensis	W. Coast of Africa	60-65	...	0·8200	34·8	41·6	...	...
23	Mocaya oil .	Cocos sclerocarpa	S. America	60-70	...	...	22	24-29	...	7·0 (R.M.
24	Maripa . .	Palma (?) Maripa	W. Indies	...	100 (15·5 = 1)	0·8686	24-25	26·5-27·0	88·88	4·45 (R.M.
25	Palm nut oil .	Elæis guineensis, E. melanococca	W. Africa, S. America	45-50	15 (15·5 = 1)	0·9520	20·5	23-28	87·6-91·1	5·6 (R.M.
26	Cocoa nut oil .	Cocos nucifera, C. butyracea	Tropics	45-63	40 (15·5 = 1)	0·9115	22-14	21-24	88·6-90	7-8·4 (R.M.
27	Myrtle wax .	Myrica cerifera, M. carolinensis	N. America	20-25	15	0·995	39-43	40-44	...	...
28	Ucuhuba . .	Myristica bicuhyba	Brazil	59	...	...	32·5	42·5-43	93·4	...
29	Japan wax .	Rhus succedanea, R. vernicifera	China, Japan	25	15	0·9700-0·9800	48·5-53	50-54	90·6	...

TABLE No. 24 D.

	Animal Fats.								
	Name of Fat.	Source.	Specific Gravity.		Solidifying Point.	Melting Point.	Insoluble Fatty Acids + Unsaponifiable (Hehner Value).	Reichert (R.) or Reichert-Meissl (R.M.) Value.	
			°C.		°C.	°C.	Per cent.	c.c. $\frac{1}{10}$ norm. KOH.	
	Drying Fats—								
1	Icebear	Ursus maritimus	15	0·9256	...	...	...	...	
2	Blackcock	Tetrao urogallus	15	0·9296	...	...	...	2·1	
3	Hare	Lepus timidus	15	0·9349	17-23	35-40	95·4	1·59	
4	Rabbit (wild)	Lepus cuniculus	15	0·9393	17-22	35-38	...	0·7	
	Non-drying Fats—								
5	Rabbit (tame)	Lepus cuniculus	15	0·9342	22-24	40-42	95·5	2·8	
6	Wild duck	Anas boschas	...	...	15-20	...	...	1·3	
7	Domestic duck	,, ,,	...	...	22-24	36-39	...	...	
8	Starling	Sturnus vulgaris	...	...	15-18	30-35	...	...	
9	Pigeon	Columba livia	...	...	...	...	...	...	
10	Turkey	Meleagris gallopavo	15	0·9220	...	...	...	...	
11	Fox	Canis vulpes	15	0·9412	24-26	35-40	...	1·3	
12	Horse	Equus caballus	15	0·9189	43-30	34-54	95-96	0·2-0·4	
13	Horse marrow	,, ,,	15	0·9204 0·9221	24-20	35-39	...	1·0	
14	Badger	Meles taxus	15	0·9226	17-19	30-35	96	0·36	
15	Pine marten	Mustela martes	15	0·9345	24-27	33-40	93	1·1	
16	Goose (domestic)	Anser cinereus	15	0·9274	18-20	32-34	95	0·98	
17	Goose (wild)	,, ,,	15	0·9158	18-20	...	...	0·2-0·4 (R.M.)	
18	Chicken	Gallus domesticus	15	0·9241	21-27	33-40	..	1·0	
19	Polecat	Mustela putorius	...	...	...	...	...	...	
20	Human	Homo sapiens	25	0·9033	15	17·5	...	0·3	
21	Lard	Sus scrofa	15	0·934-0·938	27·1 29·9	36-40·5	93-96	...	
22	Fat from wild boar	,, ,,	15	0·9424	22-23	40-44	...	0·68	
23	Dog	Canis familiaris	15	0·9229	21-23	37·5-40	95-65	0·57	
24	Wild cat	Felis catus	15	0·9304	26-27	37-38	...	2.5	
25	Domestic cat	Felis domestica	15	0·9304	24-26	39-40	96	0·9	
26	Beef marrow	Bos taurus	15	0·9311-0·9380	31-29	37-45	...	1·1	
27	Bone	,, ,,	15	0·914-0·916	15-17	21-22	...	...	
28	Beef tallow	,, ,,	15	0·943-0·952	35-27	45-40	95·6	0·25	
29	Mutton tallow	Ovis aries	15	0·937-0·953	36-41	44-45	95·5	..	
30	Butter	Bos taurus	15	0·926-0·940	20-23	28-33	86·5-89·8	12·5-15·1	
31	Elk	Cervus alces	15	0·9625	37-38	49-52	...	0·78	
32	Reindeer tallow	Cervus tarandus	...	...	...	48	...	...	
33	Roebuck	Cervus capreolus	15	0·9659	39-41	52-54	95·8	0·99	
34	Fallow buck	Cervus dama	15	0·9615	40	52-53	...	1·70	
35	Chamois	Antilope rupicapra	15	0·9697	42-43	54-56	...	1·80	
36	Stag	Cervus elaphus	15	0·9670	39-48	49-52	...	1·66	

nima

ANTS.

apon
V.

TABLE N

	Waxes		Specific Gravity.		Solidifying Point.	Melting Point.	Acid Value.	Eth Valu
	Kind of Wax.	Source.	°C.		°C.	°C.	Mgrms. KOH.	
	Liquid Waxes							
1	Sperm oil . . .	Physeter macrocephalus	15	0·8799-0·8835	...	...	...	...
2	Arctic sperm oil (Bottlenose)	Hyperoödon rostratus	15	0·8764	...	...	...	...
	Solid Waxes							
	Vegetable Waxes—							
3	Carnaüba wax .	Corypha cerifera	15	0·990-0·999	80-81	85-86	4-7	75
	Animal Waxes—							
4	Wool wax (wool grease).	Ovis aries	17	0·9413-0·9449	30-30·2	31-35	...	...
5	Beeswax . . .	Apis mellifica	15	0·964-0·970	60·5-62·8	61·5-64·4	16·8-21·2	72-7
6	Spermaceti (Cetin) .	Physeter macrocephalus	15	0·905-0·960	42-47	42-49	...	...
7	Insect wax (Chinese wax)	Coccus ceriferus	15	0·926-0·970	80·5-81	80·5-83	...	...

B. COMMERCIAL PRODUCTS OF THE FATS AND OILS INDUSTRIES

1. LUBRICANTS

TABLE No. 25 A

Viscosities of some Oils and Fats

Kind of Oil.	Number of Seconds in Redwood's Viscosimeter, 50 c.c. of water at 70° F. = 25·4 Seconds.	Kind of Oil.	Number of Seconds in Redwood's Viscosimeter, 50 c.c. of water at 70° F. = 25·4 Seconds.
Linseed	212	Garden cress	322
Tung oil	858-1433 (water 28 sec.)	Radish seed	385
		Arachis	307-429
Walnut	232	Olive	312
Safflower	249·1-294	Mahua	90-107
Poppy seed	254-259	Phulwara	110·4
Amoora	376	Malabar Tallow	101-104
Niger seed	263-293	Kokum butter	101
Argemone	269-272	Cocoanut oil	64

TABLE No. 25 B

50 c.c. of water at 60° F. requiring 25·5 seconds.

°F.	Rape Oil. Refined.	Sperm Oil.	Neat's foot Oil.	Beef Tallow.	American Mineral Oil.			Russian Mineral Oil.		
					Sp. gr. 0·885.	Sp. gr. 0·913.	Sp. gr. 0·923.	Sp. gr. 0·909.	Sp. gr. 0·915.	Sp. gr. 0·884.
50	712·5	...	...	...	145·0	425·0	1030·0	2040·0	2520·0	
60	540·0	177·0	470·0	...	105·0	295·5	680·0	1235·0	1980·0	
70	405·0	136·8	366·0	...	90·0	225·0	485·0	820·0	1320·0	
80	326·0	113·0	280·0	...	73·0	171·0	375·0	580·0	900·0	
90	260·0	96·0	219·25	...	63·5	136·0	262·0	426·0	640·0	
100	213·5	80·5	174·75	...	54·0	111·0	200·0	315·0	440·0	1015·0
110	169·0	70·5	147·4	...	50·0	89·5	153·0	226·0	335·0	739·5
120	147·0	60·5	126·0	...	47·0	78·0	126·0	174·0	245·0	531·0
130	123·5	57·0	112·0	...	44·75	63·5	101·0	135·5	185·0	398·5
140	105·5	50·75	88·4	...	41·0	58·0	82·0	116·0	145·0	317·5
150	95·5	49·0	75·5	...	37·5	52·0	70·5	95·0	115·0	250·0
160	85·0	47·5	70·0	...	...	46·0	63·5	83·5	93·5	200·0
170	76·0	46·0	62·0	...	...	...	58·0	70·5	77·5	161·0
180	69·0	44·5	56·5	...	...	...	52·5	61·5	67·5	134·5
190	64·5	43·0	53·0	...	...	...	47·0	56·5	61·0	115·5
200	58·5	42·0	50·4	54·75	...	...	42·0	48·5	54·0	99·25
210	54·0	40·75	48·5	...	...	...	40·0	...	...	85·0
220	50·0	39·0	47·0	...	...	...	38·0	...	...	77·0
230	47·25	36·75	45·8	...	...	...	...	...	...	70·5
240	45·5	35·75	44·6	...	...	...	...	...	...	64·5
250	43·25	34·75	44·0	40	...	...	...	...	...	59·25
260	...	33·75	43·5	...	...	...	...	...	...	54·0
270	...	32·75	43·0	...	...	...	...	...	...	48·5
280	...	31·85	41·5	...	...	...	...	...	...	46·5
290	...	30·75	41·0	...	...	...	...	...	...	44·25
300	...	30·0	38·0	...	...	...	...	...	...	42·4
310	...	...	35·0							
320	...	...	33·8							

TABLE No. 25 C

Kind of Oil.	Specific gravity at 15·5° C.	Number of Seconds required at		
		15·5° C.	50° C.	100° C.
Sperm oil	0·881	80	47	38
Seal oil (pale)	0·924	131 (?)	56 (?)	43 (?)
Northern whale oil	0·931	186	65	46
Menhaden oil	0·932	172	40	...
Sesamé oil	0·921	168	65	50
Arachis oil	0·922	180	64	...
Cotton seed oil (refined)	0·925	180	62	40
Niger seed oil	0·927	176	59	43
Olive oil	0·916	187	62	43
Rape oil	0·915	261	80	45
Castor oil	0·965	2420	330	60

TABLE No. 25 D

	Specific Gravity at 60° F.	Viscosity (Redwood's Viscosimeter)			Flash Point. Close Test.	Cold Test.		
		70° F.	120° F.	180° F.	°F.	°F.		
Refined Mineral Oils—		Standard for Viscosity. Sperm Oil at 70° C. = 100.						
Scotch	0·890-0·895	100-130	40-50	..	320-350	32		
	0·885-0·890	75-100	35-40	..	300-325	32		
	0·875-0·880	50-60	25-30	..	300-325	32		
American	0·915-0·920	400-425	90-100	35-40	375-425	32		
	0·905-0·910	200-225	55-65	..	350-400	32		
	0·885-0·890	75-100	35-40	..	325-350	32		
	0·875-0·880	65-75	30-35	..	325-350	32		
Russian	0·910-0·915	1200-1500	200-250	50-70	400-425	25		
	0·905-0·912	700-800	125-150	45-50	350-375	25		
	0·895-0·900	220-250	60-65	..	325-350	15		
	0·895-0·900	125-175	..	.	300-325	10		
Natural (dark) Mineral Oils—		Standard for Viscosity. Tallow at 180° C. = 100.						
American summer, dark	0·890-0·895	..	250-300	70-75	400-425	40-50		
,, medium	0·880-0·885	550-700	110-125	40-50	350-400	25-30		
,, winter	0·880-0·885	350-400	90-100	35-40	325-375	25-30		
Russian residuum	0·910-0·915	750-1000	150-200	45-60	250-300	25-30		
Natural and Filtered Mineral Oils—								
American heavy dark	0·900-0·905	..	1750-2000	350-400	500-550	40-45		
,, extra dark	0·900-0·905	..	2000-2500	400-450	525-575	35-40		
,, medium dark	0·895-0·900	..	1200-1400	300-350	500-525	40-45		
,, heavy filtered	0·890-0·895	..	1400-1500	300-350	500-550	60-70		
,, medium filtered	0·890-0·895	..	1000-1200	250-300	500-525	65-70		
,, light filtered	0·885-0·890	..	885-1000	200-250	450-500	75-80		
,, fluid filtered	0·885-0·890	..	1200-1400	300-350	500-550	40-45		
,, ,,	0·885-0·890	..	900-1000	225-275	450-500	45-50		
							No. of Samples	Flash Points. °F.
Southern sperm oil	0·8807	100·1	45·4	..	457·5*	41·7	34	420-485
Arctic sperm oil	0·8804	105·3	47·2	..	446·2*	39·2	59	390-485
White whale oil	0·9207	187·7	71·3	..	476·0*	27·2	35	430-530
Neat's foot oil	0·9178	247	82·4	..	470·8*	34·4	17	410-540
Lard oil	0·9172	223·2	79·4	..	493·9*	39·6	18	425-545
Olive oil	0·9167	213·2	75·0	..	437·5*	27	24	410-465
Rape oil, East India, refined	0·916	250·4	88·1	..	478·6*	26·4	89	410-510
,, Black Sea, refined	0·9209	226·9	78·8	..	465·4*	27	25	430-490
Cotton seed oil, refined	0·9235	190·4	69·8	..	523 *	30	22	500-540
Castor oil	0·968	2500	390	..	487 *	0		

* Mean Values.

TABLE No. 25 E

Kind of Oil or Fat.	Specific Gravity at 17·5° C.	Viscosity (Engler's Viscosimeter).			
		20° C.	50° C.	100° C.	150° C.
Rape oil, crude .	0·920	9·03	4·0	1·78	1·34
Rape oil, refined .	0·911	11·88	4·9	2·05	1·40
Olive oil . .	0·914	10·3	3·78	1·80	
Castor oil . .	0·963	...	16·46	3·01	
Linseed oil . .	0·930	6·36	3·2	1·76	
Tallow . . .	0·951	...	5·19	2·50	1·73
Neat's foot oil .	0·916	11·63	4·44	1·92	

TABLE No. 25 F

Oils.	Specific Gravity at 17·5° C.	Flash Point. °C.	Viscosity (Engler s Viscosimeter).	
			At 50° C.	At 100° C.
Russian cylinder oils . .	0·911-0·923	183-238	10·2-16·2	2·0-2·8
,, machine oils . .	0·893-0·920	138-197	5·8-6·3	1·5-1·8
,, spindle oils . .	0·893-0·895	163-167	3·1-3·4	1·4-1·5
American cylinder oils . .	0·886-0·899	280-283	...	4·1-4·8
,, machine oils . .	0·884-0·920	187-260	4·2	1·6
,, spindle oils . .	0·908-0·911	187-200	3·1-3·3	1·4-1·6
Rape oil, crude . . .	0·920	265	4·0	1·7
,, ,, refined . . .	0·911	305	4·9	2·0
Olive oil	0·914	305	3·7	1·8
Castor oil	0·963	275	16·4	3·0
Linseed oil	0·930	285	3·2	1·7
Tallow	0·951	265	5·2	2·5

2. WOOL OILS—CLOTH OILS

TABLE No. 26—*Analyses of Ordinary Wool Oils*

Source or Name.	Flash Point.	Specific Gravity at 15·5° C.	Free Fatty Acids.	Unsaponifiable.	Neutral Fat.	
					Direct.	By Difference.
	°F.		Per cent.	Per cent.	Per cent.	Per cent.
Distilled oleine from recovered grease	...	0·8894	77·2[1]	26·8	...	4·0
,, ,, ,,	...	0·9083	55·3[1]	35·9	11·6	8·8
,, ,, ,,	...	...	54·9[2]	34·5	11·28[3]	...
,, ,, ,,	338	0·9031	55·02	34·66	...	9·2
,, ,, ,,	342	0·8980	56·26	29·46	...	11·95
,, ,, ,,	322	0·9050	53·65	16·32	...	28·65
,, ,, ,,	...	0·9000	59·83	38·92	...	...
,, ,, ,,	...	0·9091	64·42	9·95	...	25·63
,, ,, ,,	415	0·941	...	41·7	...	...
	Flash Point.	Moisture.	Saponifiable.[4]	Unsaponifiable.		
	°F.	Per cent.	Per cent.	Per cent.		
Brown oleine, compound oil of English distilled and foreign oil	396	0·77	86·28	12·95	...	...
Brown foreign oleine, Belgian	354	0·75	80·56	18·69	...	...
Brown "oleine cloth oil," "manufactured"	349	0·64	73·78	25·58	...	...
"Black oil," recovered after using foreign and English distilled oleine (flannel district, Lancashire)	367	1·27	69·08	29·65	...	...
"Brown grease" recovered after using Gallipoli oil	419	1·07	69·16	29·77	...	...
Distilled oleine from brown grease and once recovered olive oil	342	0·77	62·04	37·19	...	...
"Black oil" recovered after using oleine and better class "cloth oils" (half "seek," half waste)	369	1·11	60·39	38·50	...	...
Brown oleine, distilled from brown grease	338	0·69	46·96	52·35	...	...
"Black oil," recovered after using recovered and low cloth oils (from waste)	331	0·67	32·03	67·30	...	...
"Brown pulling oil" (for rags), brown grease and hydrocarbons	374	0·74	21·01	78·25	...	...

[1] Calculated as oleic acid. [2] Mean molecular weight 286. [3] Consisting of 7·02 per cent of fatty acids and 4·26 per cent of combined alcohols. [4] By difference.

TABLE No. 27—*Analyses of Emulsion Wool Oils*

Name of Oil.	Na_2O. Per cent.	NH_3. Per cent.	Water. Per cent.	Fatty Matter. Per cent.	Fatty Acids. Per cent.	Neutral Fat. Per cent.	Unsaponifiable. Per cent.	Soda Soap Anhydrous. Per cent.	Gummy Substances. Per cent.	K_2CO_3.	Glycerol.
...	0·91	0·32	84·45	16·16							
...	...	...	76·67	20·86	...	...	...	0·91	0·72		
"Patent oil" . . .	0·41	1·36	...	...	70·0	8·7	6·9				
...	...	12·50	34	...	45·0	7·0	...	1·5			
"Soluble Neoline" (calculated)	...	...	56·18	...	...	...	...	8·4	...	4·55	14·05

TABLE No. 28—*Heat Test of Wool Oils* (by Mackey's Cloth Oil Tester)

No.	Oil Used.	Temp. in 1 hr.	Temp. in 1 hr. 15 m.	Temp. in 1 hr. 30 m.	Temp. in 2 hrs.	Maximum.	
		°C. = °F.	°C. = °F.	°C. = °F.	°C. = °F.	°C. = °F.	H.M.
1	Cotton seed	125 = 257	242 = 468	... ...	... ...	242 = 468	1 15
2	,, ,, ...	121 = 250	242 = 468	282 = 540	... ...	284 = 543	1 35
3	,, ,, ...	128 = 262	212 = 414	225 = 437	... ...	225 = 437	1 30
4	,, ,, ...	124 = 255	210 = 410	... ...	... ...	248 = 478	1 35
5	,, ,, ...	116 = 241	192 = 378	200 = 392	... ...	200 = 392	1 30
6	,, ,, ...	118 = 244	191 = 376	202 = 396	... ...	202 = 396	1 30
7	,, ,, ...	117 = 243	190 = 374	194 = 381	... ...	194 = 381	1 30
8	,, ,, ...	112 = 234	177 = 351	204 = 399	... ...	211 = 412	1 45
9	Olive fatty acids	114 = 237	177 = 351	... ...	... ..	196 = 385	1 25
10	,, ,, ...	105 = 221	165 = 329	... ...	... ...	293 = 559	1 55
11	,, ,, ...	102 = 216	135 = 275	208 = 406	... ...	226 = 439	1 45
12	White Australian oleine	103 = 217	115 = 239	191 = 376	... ...	230 = 446	1 45
13	Olive	98 = 208	102 = 216	104 = 219	... ...	241 = 466	3 25
14	Oleine	98 = 208	101 = 214	102 = 216	... ...	110 = 230	2 8
15	97% oleine	98 = 208	100 = 212	102 = 216	... ...	172 = 342	3 15
16	Belgian oleine	98 = 208	99 = 210	100 = 212	... ...	173 = 343	3 16
17	Olive (neutral)	98 = 208	100 = 212	101 = 214	... ...	235 = 455	5 15
18	,, ,, ...	97 = 207	100 = 212	101 = 214	... ...	228 = 442	4 30
19	,, ,, ...	97 = 207	... ...	101 = 214	... ...	235 = 455	4 55
20	Cotton	139 = 282	... ...	... ...	... ...	200 = 392	1 4
21	Olive	99 = 210	101 = 214	102 = 216	103 = 217	113 = 235	4 30
22	Mixture of 50% of No. 20 and 50% of No. 21 .	102 = 216	117 = 243	... ...	... ...	200 = 392	1 29
23	,, 25 ,, ,, 75 ,, .	99 = 210	105 = 221	112 = 234	... ...	200 = 392	1 52
24	,, 10 ,, ,, 90 ,, .	99 = 210	102 = 216	105 = 221	127 = 261	200 = 392	2 9

3. SOD OILS—DÉGRAS

TABLE NO. 29

Analyses of some Oils and the Sod Oils made therefrom

Name of Oil.	Specific Gravity.		Refractive Index.		Fatty Acids Insoluble in Petroleum Ether.		Acid Value.		Saponification Value.		Iodine Value.	
	Original Oil.	Dégras.	Original Oil.	Dégras.	Original Oil.	Dégras.	Original Oil.	Dégras.	Original Oil.	Dégras.	Original Oil.	Dégras.
					Per cent.							
Shark liver oil . . .	0·9158	0·9212	1·4735	1·4752	0·91	1·70	7·0	8·4	157·2	143·2	90	82·4
Seal oil	0·9258	0·9465	1·4760	1·4790	2·70	14·41	6·1	26·1	193·8	190·5	96·5	68·4
Mixed fatty acids from seal oil	0·9354	0·9473	...	...	3·0	15·51						
Cod liver oil . . .	0·9274	0·9836	1·4755	1·4780	0·87	19·40	13·6	28·3	187·9	183·4	14·8	100·5
Mixed fatty acids from cod liver oil	0·9375	0·9612	...	...	1·21	18·44						
Whale oil	0·9270	0·9423	1·4755	1·4758	3·44	6·19	10·6	10·6	190·4	181·5	85	71

TABLE NO. 30

Analyses of some American Sod Oils

Sod oil.	Ash.	Moisture.	Oil, etc., Soluble in Petroleum Ether.	Soap, etc., Soluble in Alcohol.	Hide Fragments.	Ash Insoluble in Petroleum Ether and Alcohol.	Total.	Dégras-former.	Mgrms. KOH.	Free Fatty Acid.	Reichert-Meissl Value.	Iodine Value.	Unsaponifiable.	Iodine Value of Unsaponifiable.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per 1 grm. of oil.	Per cent.	Cc. $\frac{1}{10}$ norm. KOH.	Per cent.	Per cent.	Per cent.
1. Yellow . .	0·96	25·27	72·60	1·90	0·66	0·12	100·55	0·93	99·07	27·43	1·87	52·45	20·60	31·76
2. Brown . .	0·70	3·38	88·61	7·05	1·05	0·15	100·24	15·98	206·51	72·64	2·66	60·54	0·95	9·38
3. Brown . .	0·215	2·75	96·60	1·32	1·09	0·16	101·92	2·73	111·52	44·69	2·53	43·56	41·46	16·89
4. Yellow . .	0·05	19·48	...	...	...	...	....	...	108·75	26·13	2·24	55·02	18·95	22·48
5. Brown . .	1·045	15·45	75·37	7·24	1·26	0·47	99·79	6·33	140·59	73·18	2·41	46·69	14·90	20·80
6. Yellow . .	0·68	30·87	59·74	8·81	0·49	0·06	99·97	2·65	85·70	32·99	1·35	49·03	14·99	23·66
7. Brown . .	0·37	4·59	89·59	3·09	2·99	0·15	100·41	21·41	181·53	19·40	1·66	59·06	0·58	3·22
8. Brown . .	0·77	33·46	58·81	5·40	2·24	0·35	100·26	17·73	135·83	17·96	3·72	44·17	2·80	52·07
9. Brown . .	0·55	1·01	95·69	2·44	0·79	0·13	100·06	13·91	186·53	34·00	2·58	77·53	0·37	71·58
10. Brown, thick .	0·36	40·61	56·62	3·19	0·31	0·22	100·95	0·65	64·04	47·51	2·02	22·79	21·81	13·80
11. Brown, thin .	0·28	3·94	94·38	2·57	0·15	0·16	101·20	2·74	101·48	39·63	2·33	47·19	29·85	25·19
12. Brown . .	0·46	23·70	73·36	0·68	1·29	0·15	99·18	8·41	109·94	20·32	3·87	41·01	6·32	20·95

TABLE No. 31.—*Analyses of some Dégras*

		1	2	3	4	5	6	7
Water . . .	Per cent	18·90	14·84	12·93	28·90	19·20	5·39	8·90
Ash . . .	,,	0·25	0·13	0·55	0·70	0·07	0·25	1·21
Hide fragments .	,,	0·30	0·30	0·09	0·58	0·27	...	1·59
Oils . . .	,,	69·71	74·65	80·00	66·93	75·66	84·87	72·15
Unsaponifiable .	,,	6·84	6·05					
Resinous substance	,,	4·00	4·05	5·81	3·52	4·80	9·46	16·15

	Dégras-former.	Melting Point of Fatty Acids.	Soap.	Original Dégras.	
				Hide Fragments.	Water.
	Per cent.	°C.	Per cent.	Per cent.	Per cent.
French dégras, anhydrous, No. 1	19·14	18·0-28·5	0·73	0·07	16·5
,, ,, ,, 2	18·43	28·5-29·0	0·49	0·12	20·5
,, ,, ,, 3	18·10	31·0-31·5	0·68	0·18	12·0
Sod oil ,, ,, 1	20·57	33·5-34·0	3·95	5·7	35·0
,, ,, ,, 2	18·63	27·5-27·0	3·45	5·9	28·0
,, ,, ,, 3	17·84	28·0-28·5	3·00	4·5	30·5

TABLE No. 32.—*Analyses of Some Dégras*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Iodine Value.				Acid Value.		Saponification Value.		Ether Value.				
No. of Sample.	Water.	Original Dégras.	Anhydrous Dégras.	Insoluble Fatty Acids.	Acetylated Fatty Acids.	Original Dégras.	Anhydrous Dégras.	Original Dégras.	Anhydrous Dégras.	Original Dégras (Difference between 7 and 9).	Anhydrous Dégras (Difference between 8 and 10).	Constant Acid Value.	Constant Saponification Value.	Constant Ether Value (Difference between 13 and 14).
	Per cent.													
1	19·1	60·4	74·7	70·5	73·1	30·5	37·7	...	...	...	...	185·5	224·3	38·8
2	12·9	55·9	64·2	58·6	52·7	63·3	72·7	96·2	110·4	32·9	37·7	102·8	131·5	28·7
3	12·4	67·8	77·4	75·4	90·4	35·2	40·2	97·0	110·7	62·2	70·5	129·6	172·9	43·4
4	15·9	65·9	78·4	70·2	66·6	42·1	50·1	113·4	134·8	71·3	84·7	162·9	193·7	30·8
5	16·4	65·0	77·8	78·5	76·2	44·1	52·7	114·9	137·4	70·8	84·7	163·5	185·9	22·4
6	11·5	67·8	76·6	76·5	75·7	57·4	64·9	96·3	108·8	38·9	43·9	175·8	229·6	53·8
7	13·9	83·3	96·7	95·9	88·9	...	...	...	...	...	...	182·5	215·6	33·1
8	17·3	69·2	83·7	93·4	102·7	23·9	28·9	83·4	100·8	59·5	71·9	96·7	197·1	100·4
9	16·6	67·5	80·9	...	...	43·4	52·0	117·8	141·2	74·4	89·2			
10	5·3	70·5	74·4	79·3	73·0	51·2	54·1	118·6	125·2	67·4	71·1	179·5	210·2	30·7
11	...	127·7	127·7	142·3	127·4	...	...	...	163·8	...	...	180·8	212·2	31·4
12	...	...	126·7	106·0	101·9	...	...	...	186·0	...	...	159·3	213·2	53·9
Mean of 1-10	...	...	78·5	77·6	77·7	...	50·4	...	121·2	...	70·8	153·2	195·6	42·4

TABLE NO. 33.—*Analyses of Dégras and Similar Products*

No.		Water.	Ash.	Insoluble in Petroleum Ether.	Fatty Matter.	Unsaponifiable Matter.	Oxidised Acids (Dégras-former.)	Anhydrous Fat.		
								Acid Value.	Saponification Value.	Iodine Value.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.			
1	Dégras	13·31	0·32	0·31	86·1	3·1	11·03	108·0	185·8	69·0
2	,,	10·05	0·18	0·24	89·5	3·4	14·13	119·0	188·0	52·8
3	,,	10·24	0·28	0·28	89·2	1·0	1·49	104·0	181·8	70·7
4	,,	8·49	0·06	0·31	91·1	0·91	9·25	34·5	208·5	106·0
5	,,	17·33	0·27	0·14	82·3	2·51	0·95	29·2	206·0	122·0
6	,,	10·59	0·20	0·10	89·1	3·1	10·93	112·0	181·2	63·9
7	,,	1·53	0·70	0·04	97·7	1·85	16·17	112·0	170·0	62·5
8	Moëllon, pure	18·45	0·07	0·09	81·4	2·04	11·65	25·7	215·5	89·1
9	,,	19·88	0·03	0·46	79·63	0·45	1·46	47·4	214·0	115·0
10	Moëllon-dégras	11·65	0·63	0·98	86·74	3·27	2·01	17·4	196·7	126·0
11	Oxidised blubber oil	10·43	0·50	0·21	88·86	1·44	1·61	17·0	192·3	129·0
12	Oxidised emulsion fat	7·45	0·41	0·08	92·1	2·72	9·74	17·0	196·3	107·8
13	Of French origin. Dégras	13·88	0·14	0·22	86·8	40·6	4·06	35·0	99·8	52·9
14	,,	14·16	0·58	0·97	84·3	18·9	3·73	32·4	137·4	80·6
15	,,	25·46	0·07	1·25	73·22	14·29	5·99	33·0	206·4	101·8
16	,,	18·79	0·46	0·31	80·44	23·61	5·33	31·0	135·4	72·3
17	Dégras-moëllon	15·79	0·05	0·22	83·94	28·1	1·84	40·5	113·2	72·1
18	Dégras	7·59	0·26	0·38	91·8	33·12	3·39	39·7	93·0	49·9
19	"Mutton-dégras"	16·49	0·31	0·74	82·5	8·5	5·51	39·4	194·0	104·5
20	Dégras-moëllon	14·29	0·29	0·38	85·04	14·1	4·96	38·4	180·0	102·0
21	Dégras	20·37	0·08	0·45	79·1	40·3	2·95	24·0	86·0	49·5
22	,,	30·29	0·25	0·22	69·24	2·23	6·55	54·6	201·0	90·0
23	Fat from sod oil	...	...	...	100·0	0·71	16·84	71·3	234·0	61·0

TABLE No. 34—*Analyses of Dégras*

No.		Specific Gravity at 18° C.	Water.	Ash.	Insoluble in Petroleum Ether.	SO_3.	Unsaponifiable Matter.	Oxidised Acids (Dégras former).		Acid Value of		Saponification Value of		Iodine Value of	
								in Original Substance.	in Anhydrous Substance.	Original Substance.	Anhydrous Substance. (calculated).	Original Substance.	Anhydrous Substance (calculated).	Original Substance.	Anhydrous Substance (calculated).
			Per cent.	Per cent.	Per cent.	Per cent.	Per cent.								
1	Natural dégras from chamoising .	1·0025	31·13	1·83	5·07	0·47	2·36	18·03	26·38	35·75	51·75	155·0	221·0	35·7	52·3
2	,, ,, ,, .	0·9993	39·60	1·79	5·18	0·20	1·26	14·09	23·44	25·08	41·72	144·0	239·0	34·0	56·4
3	Fish oil, used in dégras manufacture	0·9172	0·20	0·03	...	0·0	1·30	3·79	3·80	9·39	...	192·3	192·3	139·7	139·7
4	Commercial "dégras," German .	0·9435	17·74	0·11	0·15	0·0	1·16	9·66	11·77	16·64	20·02	172·0	209·0	69·0	83·8
5	,, ,, French. .	0·9495	18·13	0·32	trace	0·0	19·61	2·03	2·48	22·49	27·46	131·2	160·0	64·4	78·9
6	,, ,, French. .	0·9445	17·35	0·49	trace	0·03	2·25	6·65	8·04	11·72	14·18	164·0	198·0	95·6	115·6
7	,, ,, French. .	0·9466	20·78	0·38	trace	0·04	1·88	9·44	11·92	11·55	19·62	160·0	193·0	53·8	65·3
8	,, ,, German .	0·9493	22·89	0·60	0·23	0·02	8·75	9·11	11·81	11·83	15·35	126·0	163·4	44·7	58·0
9	,, ,, German .	0·9493	21·33	0·55	0·30	0·06	15·77	4·30	5·47	11·49	14·61	105·0	129·0	39·6	50·4
10	,, ,, French. .	0·9498	21·40	0·10	0·12	0·02	30·56	5·40	6·87	19·29	24·54	95·0	120·9	45·4	57·7
11	,, ,, Belgian .	0·9506	22·70	0·08	0·32	0·04	22·26	6·18	7·99	18·77	24·28	92·5	119·2	46·1	59·6
12	,, ,, Belgian .	0·9516	10·89	0·31	0·86	0·02	17·59	4·90	5·50	12·63	14·27	136·0	152·6	50·2	50·7

4. OXIDISED OILS

a. BLOWN OILS

TABLE No. 35.—

I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
No.	Oil.	Specific Gravity at 15·5° C. (Water 15·5 = 1).	Free Acid Calculated as Oleic.	Unsaponifiable Matter.	Saponification Value.	Reichert-Meissl Value.	Iodine Value.	Specific Temperature Reaction.
			Per cent.	Per cent.				
1	Rape	0·9141	5·10	0·65	173·9	...	100·5	135
2	No. 1, blown 5 hours .	0·9275	5·01	...	183·0	...	88·4	
3	No. 1, blown 20 hours	0·9615	7·09	0·76	194·9	...	63·2	...
4	Commercial blown rape oil	0·9674	4·88	...	267·5	8·8	65·3	...
5	Sperm	0·8797	1·97	36·32	130·4	...	82·1	
6	No. 4, blown 25 hours	0·8989	3·27	34·65	142·3	...	67·1	
7	Commercial blown rape	0·9672	4·93	2·80	197·7	...	63·6	253
8	Commercial blown cotton seed	0·9740 At 20° C. Water 20° = 1	3·38	1·00	213·2	...	56·4	227
9	Commercial blown seal	0·9815	16·5	...	221·0	...	78·2	...
10	Cotton seed	...	1·1	1·05	190·4	...	108·8	...
	Oxidised cotton seed obtained by exposure on chamois leather and exhausting with petroleum ether							
11	After 8 days	...	6·69	1·13	223·1	...	55·4	...
12	After 12 days . . .	...	6·94	1·33	227·5	...	46·3	...
13	Oil obtained by subsequent exhaustion with ether of the leather extracted with petroleum ether	...	16·79	0·72	271·3	...	29·1	...

Some Constants and Variables of Blown Oils

X.	XI.	XII.	XIII.	XIV.			XV.	XVI. = X. − (V. + XV.).			
				Molecular Weight of							
Insoluble Acids (Hehner Value).	Soluble Volatile Acids.	Soluble Non-Volatile Acids.	Iodine Value of Insoluble Acids.	Insoluble Acids.	Soluble non-volatile Acids.	Soluble Volatile Acids.	Oxidised Acids.	Non-volatile Fatty Acids freed from Oxidised Acids and Unsaponifiable Matter.			
Per cent.	Per cent.						Per cent.	Per cent.	Molecular Weight.	Melting Point °C.	
94·76	0·52										1
											2
85·94	9·20	0·82	66·5	327·0	241	72					3
88·64	...	...	...	294·1							4
											5
82·40	11·16	9·00	70·2	317·0	...	76					6
84·97	1·90	1·94	62·7	296·0	...	104					7
											8
73·4											9
94·22	...	...	...	...	...	...	0·27	92·9	278·1	35·36	10
85·34	...	...	...	...	...	...	20·62	63·59	276·2	45·46	11
93·62	...	...	...	...	...	...	19·13	63·16	273·2	46	12
74·20	...	...	...	...	...	...	37·72	35·76	269·1	51	13

TABLE No. 36.—*Analyses of some Oils and their Blown Oils* (Lewkowitsch)

	Original Oil.				Acetylated Oil.					
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
	Specific Gravity, at 15·5° C.	Saponification Value.	Total Volatile Fatty Acids per Gramme in terms of Milligrammes KOH.	Oxidized Acids. Per cent.	Saponification Value.	Hehner Value.	Apparent Acetyl Value.	True Acetyl Value.	VIII. × ·55.	Difference V.-II.
Linseed oil	...	...	0·8	...	205·6	96·2	12·5	11·7	6·4	
Linseed oil, blown two hours at 120° C.	0·9334	189·8	1·68	1·2	200·9	94·4	18·9	17·22	9·47	11·1
Linseed oil, blown four hours at 120° C.	0·9403	191·3	3·0	1·7	203·9	94·6	22·5	19·5	10·72	12·6
Linseed oil, blown six hours at 120° C.	0·9446	192·4	8·3	5·03	208·2	93·2	25·5	17·2	9·46	15·8
Linseed oil, blown ten hours at 120° C.	0·9460	192·7	0·9	7·1	211·8	92·1	32·6	31·7	17·4	19·1
Cotton-seed oil	...	...	0·1	...	200·2	95·7	7·7	7·6	4·18	
Cotton-seed oil, blown two hours at 120° C.	0·9262	194·3	2·88	0·51	203·9	94·8	14·2	11·32	6·23	9·6
Cotton-seed oil, blown four hours at 120° C.	0·9291	194·9	2·44	0·87	212·0	92·9	22·9	20·46	11·25	17·1
Cotton-seed oil, blown six hours at 120° C.	0·9350	196·1	4·60	0·94	215·2	91·9	30·0	25·4	13·97	19·1
Cotton-seed oil, blown ten hours at 120° C.	0·9346	196·8	4·16	1·28	218·4	91·4	35·0	30·84	16·96	21·6
Premier jus	...	...	0·58	...	199·6	...	3·3	2·72	1·49	
Premier jus, blown four hours at 120° C.	...	202·3	...	0·70	211·6	92·6	18·8			
Oleic acid	...	...	0·95	...	203·7	99·9	3·0	2·05	1·13	9·3
Oleic acid, blown two hours at 120° C.	0·9098	204·9	2·9	0·62	211·1	98·5	14·2	11·3	6·21	6·2
Oleic acid, blown four hours at 120° C.	0·9121	206·0	3·6	2·6	217·3	99·4	18·2	14·6	8·03	11·3
Oleic acid, blown six hours at 120° C.	0·9123	208·3	4·3	3·5	223·3	97·8	23·9	19·6	10·78	15·0
Oleic acid, blown ten hours at 120° C.	0·9238	213·4	2·9	6·0	227·5	97·5	22·3	19·4	10·67	14·1
Blown rape oil, commercial	0·9714	205·6	8·9	24·95	...	...	62·04	53·14	29·22	
Blown cotton-seed oil, commercial	0·9722	213·7	16·06	26·45	...	...	65·6	48·54	26·7	
Boiled oil, commercial, I.	...	188·7	1·6	6·5	207·4	91·5	25·6	24·0	13·2	18·7
Boiled oil, commercial, II.	...	186·1	1·1	4·63	199·7	92·8	18·0	16·9	9·29	13·6
Drying oil, prepared with ozone, I.	...	...	3·2	2·15	208·2	91·5	29·7	26·5	14·57	
Drying oil, prepared with ozone, II.	...	...	4·2	3·85	211·6	91·7	24·3	20·1	11·06	
Oxidised acids from solidified linseed oil	Acid value 168	199·2	...	100·0	316·0	...	130·2	...	71·6	136·8

4. OXIDISED OILS

(*b*) BOILED OILS AND THEIR RAW MATERIALS

TABLE

Oxygen Absorption by the

(Approximate

		Increase in							
		1½ Days.	2 Days.	2½ Days.	3 Days.	3½ Days.	4 Days.	4½ Days.	5 Days.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Linseed oil, Indian	0·3-3·0	...	1·7-8·8	...	6·2-15·9	...	12·3-17·2	...
2	,, artists' oil	1·3-1·8	...	...	...	2·7-14·3	...	5·6-18·3	...
3	,, kept five years in well-corked bottle	2·2-2·7	...	10·5-?	...	19·7-19·9	...	Decrease	...
4	,, kept three years in not well-corked bottle	?-6·2	...	14·2-15·3	...	15·1-15·7	...	Decrease	...
5	Tung oil, A	0·4	...	...	0·8-3·6	...	...	...	9·1-10·9
6	,, B	0·9-2·6	...	?-12·4	?-15·9	3·1-?	...	...	10·5-15·0
7	,, C	...	...	11·1-10·6	...	...	...	...	12·9-14·8
8	,, D	...	...	10·6	...	...	...	...	14·8
9	Hemp seed oil	?-2·4	...	?-9·0	...	?-12·8	13·6-?	?-13·4	...
10	Poppy seed oil	1·3	...	3·2	...	5·1	...	8·3	...
11	Rape oil	4·9	...	5·3	...	...	...	...	...
12	,, blown	3·1	...	4·2	...	...	...	...	...
13	Peach kernel oil	...	2·5	...	2·5	...	...	...	4·3
14	Olive oil	...	0·8	...	...	...	1·7	...	...
15	Palm kernel oil	...	0·2	...	...	...	...	...	0·6

No. 37

Glass-Plate Method (Weger)

numbers only)

Weight after													
6 Days.	6½ Days.	8 Days.	9 Days.	11 Days.	13 Days.	15 Days.	17 Days.	20 Days.	26 Days.	29 Days.	42 Days.	54 Days.	
Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	
16·8-17·3	...	Decrease											1
15·4-16·7	...	?-18·7	Decrease										2
													3
													4
12·2-?	...	13·4-13·6	Decrease										5
12·9-14·6	...	14·1-?	Decrease										6
Decrease													7
Decrease													8
Decrease													9
11·6	13·4	...	Decrease										10
...	7·6												11
...	4·9	...	...	...	6·6	7·7	...	...	...	...	8·0		12
4·6	...	6·2	...	6·8	7·1	7·1	...	7·4	8·6	10·5			13
1·7	...	...	...	3·1	3·6	...	4·2	5·2					14
..	...	...	0·6	...	0·8	...	1·8	...	...	...	...	1·2	15

		3 Hours.	5 Hours.	8½ Hours.	9 Hours.	12 Hours.	16 Hours.	
1	Linseed oil, Indian, heated a short time to 150° C.	...	...	...	...	...	...	
2	,, ,, ,, blown in the cold 25 hours	...	...	...	...	...	...	
3	,, ,, ,, blown in the cold 25 hours, then 25 hours at 150° C.	...	...	...	...	...	...	
4	,, ,, Artists', freed from mucilage, by rapid heating to 280° C.	...	...	...	...	...	...	
5	,, ,, ,, freed from mucilage, by rapid heating to 280° C., then heated to 360° C for a short time	...	...	...	...	...	...	
6	,, ,, heated to 250° C. by superheated steam	...	...	...	...	...	...	
7	,, ,, fatty acids, filtered off from solid acids.	...	...	...	...	...	...	1
8	Boiled oil	...	...	...	...	...	...	9·
9	,, ,, prepared in the cold with 2 per cent. lead mangano resinate from linseed oil	...	14·1	17·5	...	...	...	
10	,, ,, from same oil, freed from mucilage and treated with 2 per cent. as above	...	15·3	17·4	...	...	...	
11	,, ,, from same oil, blown in the cold and treated with 2 per cent. as above	...	12·8	16·7	...	...	...	1
12	,, ,, from same oil, blown at 150° C. and treated as above	...	14·5	16·5	...	...	...	1
13	,, ,, from tanked oil, prepared in the cold with Mn resinate (0·1 per cent. in the boiled oil)	...	...	...	...	2·3-11·5	...	1
14	,, ,, same boiled oil, heated to 170-180° C. for a short time	...	...	...	...	...	?-14·3	1
15	,, ,, prepared commercially with litharge . .	?-3·2	...	...	?-12·9	...	14·6-?	1
16	,, ,, prepared commercially with manganic oxide hydrated (0·3 per cent at 220° C.)	?-0·9	...	...	?-1·3	...	0·8-13·6	1
17	,, ,, by heating raw oil with 0·4 per cent. PbO to 200° C.	...	...	...	...	...	...	7
18	,, ,, by heating raw oil with 3 per cent. red lead to 200° C.	...	...	...	...	...	...	12
19	,, ,, "electric"	...	...	...	...	6·8-6·2	...	13
20	,, ,, "ozonised," prepared with PbMn resinate .	...	...	...	5	...	...	12
21	,, ,, PbMn, English	...	...	...	...	15·2	...	14
22	,, ,, double boiled	...	...	...	...	...	16·4	16
	Varnish Oils, prepared by dissolving in 3 parts of boiled oils (Mn)—							
23	(*a*) 2 parts rosin "J" at 130° C.	...	...	...	...	...	1·7-?	11
24	(*b*) ,, ,, heated previously 20 hours to 150° C.	...	...	...	...	...	11-?	13·
25	(*c*) ,, ,, hardened with 8 per cent. CaO, and dissolved at 170-180° C.	...	...	...	...	...	11·3-?	11·
26	(*d*) 2 parts Dammara resin at 170-180° C. . . .	...	...	...	...	...	11-?	11
27	(*e*) 2 parts Zanzibar copal at 170-180° C. . . .	...	...	...	...	...	13·2-?	13·
28	(*f*) 2 parts Manila copal at 170-180° C. . . .	...	...	...	...	...	...	12·
	Rosin Oils—							
29	A. Specific gravity 0·980 at 14° C.	...	...	...	...	...	...	−3· to −1.
30	,, Same oil after dissolving in it 6 per cent. PbMn resinate at 120° C.	...	...	...	...	...	...	8·5-3
31	B. Obtained from oil A after distilling off 30 per cent.	...	...	...	...		..	- 1·
32	,, Oil B after dissolving in it 6 per cent. PbMn resinate at 120° C.	...	...	...	...		...	14·

TABLE No. 39.—*Oxidised Oils prepared by Treatment with Oxygen*

	Oils.						Mixed Fatty Acids.				
	Specific Gravity at 15° C.	Free Acid calculated as Oleic Acid.	Saponification Value. Mgrms. KOH.	Unsaponifiable Matter.	Oxidised Acids.	Iodine Value.	Melting Point.	Solidifying point.	Mean Combining Weight.	Saturation Number.	Iodine Value.
		Per cent.		Per cent.	Per cent.		°C.	°C.			
Oxidised oil, weak .	1·03	18·28·4	221	0·89	42·82	58·8	28	26	241·4	232·4	63:2
,, ,, strong .	1·05	18·49-28·9	223·5	0·97	44·19	53·5	27	25	242·5	231·3	60·6
Dried linseed oil. .	...	12·67	171·6	0·81	31·58	93·9	26	22	268·8	208·7	100·3

TABLE No. 40.—*Some Constants and Variables of Commercial Boiled Oils*

Consistency.	Spec. Grav. at 15·5° C.	Acid Value.	Saponific Value.	Hehner Value.	Iodine Value.	Unsaponifiable.	Oxidised Acids in	
							Boiled Oil.	Dried Oil.
				Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Somewhat thin and fluid . . .	...	13·4	...	...	101·3	...	0·5	30·6
Very viscid	...	24·9	...	...	77·3	...	4·1	20·8
Tacky, yielding "strings" . . .	...	32·6	...	...	73·7	...	7·6	16·4
...	...	...	188·1-192	92-92·3 (2 samples)	145·1-157·2	0·3-0·72		
...	...	...	...	...	149·7-153·4			
...	...	...	...	...	...	0·43-1·71		
Very thin	0·947	8·85	182·2	...	...	2·34		
Thin	0·948	7·06	180·9	...	...	1·27		
Thin	0·961	12·43	179·5	...	...	2·11		
Stout	0·972	19·69	189·3	...	...	2·01		
Stout	0·982	20·89	185·6	...	...	2·04		
Very Stout	0·983	24·97	183·0	...	...	2·14		
Solid	...	14·02	193·9	...	...	2·08		
Varying in consistency in the same order, from thin to very viscous . . .	...	4·8	188·7	...	159·0			
	...	5·2	189·1	...	100·7			
	...	7·8	189·1	...	95·6			
	...	9·5	186·6	...	83·6			
	...	9·1	187·2	...	79·1			
	...	11·7	187·2	...	76·2			
	...	18·8	192·3	...	71·1			

TABLE NO. 41.—*Some Constants and Variables of Gums used in Varnishes* (Lewkowitsch)

	Original Gums.						Gums after Heating to 300° C.				
	Acid Value.	Sap. Value.	Unsap., Per cent.	Iodine Value. ICl.	Iodine Value. Br.	Sol. in Alcohol, Per cent.	Acid Value.	Sap. Value.	Unsap., Per cent.	Iodine Value. ICl.	Iodine Value. Br.
Copal, Commercial	109·8	143·1	7·96	135·5	183·6	93·06	26·49	85·4	14·73	124·3	181·3
Copal, Commercial	42·43	66·82	14·99	191·2	114·6	54·83	24·94	61·04	46·40	143·7	233·5
Copal, Sierra Leone	72·83	119·03	18·81	105·7	96·05	...	12·89	114·9	17·22	125·5	173·6
Copal, Manila	127·6	175·17	15·98	137·9	188·2	...	68·21	136·3	22·99	133·3	186·4
Copal, Brazil	108·99	171·4	7·66	127·7	72·66	...	46·25	113·8	38·74	136·7	225·9
Copal, Sierra Leone	65·7	110·5	16·27	94·55	117·0	...	15·32	123·8	22·31	95·23	135·4
Cowrie	37·39	53·84	20·07	90·99	...	...	17·14	61·07	10·39	67·70	74·71
Mastic	52·73	81·79	51·13	175·7	185·0	84·41	23·23	50·24	49·28	165·0	217·8
Shellac, Dark	61·13	203·0	3·56	35·57	13·25						
Sandarac, Mogador	134·39	143·42	13·2	112·2	99·98	...	64·84	136·14	14·28	126·4	69·13
Sandarac, Austral	131·15	134·32	17·44	125·4	63·83	...	106·6	137·26	9·93		
Animis No. 1	18·69	73·15	6·3	105·3	182·7	...	9·25	58·73	...	106·1	207·4
Animis No. 2	30·22	93·5	6·85	96·21	95·85						
Dammar	35·22	32·73	75·96	127·5	169·4	...	10·85	60·44	86·57	127·0	196·8
Amber	16·7	121·27	18·86	58·98	82·82						
Succinit	11·24	113·68	7·06	55·05	78·4	...	10·60	99·19	16·25	74·34	147·8
Colophony	...	...	...	...	...	...	146·46	153·01	15·94	133·7	302·1

TABLE NO. 42.—*Analyses of Lithographic Varnishes prepared by Boiling over Fire*

	Oils.						Mixed Fatty Acids.					
	Specific Gravity at 15° C.	Free Acids calculated as Oleic Acid.	Saponification Value. Mgrms. KOH.	Unsaponifiable Matter.	Oxidised Acids.	Iodine Value.	Specific Gravity at 15·5° C.	Melting Point. °C.	Solidifying Point. °C.	Mean Combining Weight.	Saponification Value. Mgrms. KOH.	Iodine Value.
		Per cent.		Per cent.	Per cent.							
Raw linseed oil	0·9321	0·85	194·8	...	0·30	169·0	0·923	24-26·5	...	286·5	195·8	145·5
"Tint" varnish	0·9584	1·46	197·5	...	1·50	113·2	0·941	20·5	15	...	...	118·3
"Thin" varnish	0·9661	1·76	196·9	0·62	2·50	100·0	0·949	22	18	...	...	108·8
"Middle" varnish	0·9721	1·71	197·5	0·85	4·20	91·6	0·950	24	22	272·6	205·8	97·7
"Strong" varnish	0·9741	2·16	190·9	0·79	6·50	86·7	0·953	25·5	24	270·1	207·7	87·3
"Extra strong" varnish	0·9780	2·51	188·9	0·91	7·50	83·5	0·955	27	23	269·8	207·9	90·8
"Burnt" thin varnish	0·9675	6·93	195·5	1·35	0·85	92·7	...	23	19	...	...	99·3

TABLE No. 43.—*Some Commercial Driers*

		Proportion of Metal.		Minimum temperature at which the compound forms "boiled" oil.	Remarks.
		Theory.	Means in commercial product.		
		Per cent.	Per cent.	°C.	
1	Manganese dioxide	63·2	55 (30-60)	abt. 250	
2	Manganese oxide hydrated	62·5	45-50	170-200	Degree of fineness plays an important part.
3	Manganese peroxide hydrated	52·4	45-50	better at 200-220	
4	Lead oxide (Litharge)	92·8	about 93	in the cold.	
5	Red lead (Minium)	91·2	about 91		
6	Manganese borate	...	15 (5-22)		
7	Manganese acetate, cryst.	22·5	about 22		Melt in water of crystallisation; used best as anhydrous salts.
8	Sugar of lead, cryst.	54·6	about 54		
9	Manganese oxalate	30·4	about 30	above 280	
10	Manganese carbonate	41·4	about 41	about 280	
11	Manganese resinate, precipitated	abt. 7·7	about 7	Soluble in the cold.	Soluble driers.
12	Manganese resinate, fused	abt. 5·3	2·5-4·5		
13	Manganese linoleate	abt. 8·9	about 9		
14	Mangano-lead resinate, fused	...	...		
15	Mangano-lead linoleate	...	...		
16	"Siccative powdered"	...	0·5-3		

5. VULCANISED OILS

TABLE No. 44.—*Vulcanised Oils—India Rubber Substitutes*

Oils vulcanised with S_2Cl_2.	Sulphur.	Chlorine.	Water.	Residue on Ignition.	Fatty Acids.	Iodine Value.	Acetyl Value.	Fatty Acids.		
								Sulphur.	Chlorine.	Iodine Value.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.		Per cent.	Per cent.	
Linseed oil rubber substitute from raw oil . .	9·34	8·84	3·02	...	79·6	56·3	21·0	9·88	Trace	160·3
Linseed oil ,, ,, ,, blown oil .	4·78	4·85	0·85	...	81·67	52·6	19·6	4·06	0·60	141·2 121·0
Rape oil ,, ,, ,, commercial oil	8·28	7·62	...	...	86·89	32·5	31·0	8·34	Trace	101·5
Rape oil ,, ,, ,, blown oil .	6·59	5·95	...	...	87·95	26·9	...	6·54	Trace	102·8
Poppy seed oil ,, ,, ,, blown oil .	7·68	7·44	...	...	74·90	33·6	...	8·32	...	133·3
Cotton seed oil ,, ,, ,, blown oil .	6·23	5·36	...	...	...	30·3	51·3	6·44	Trace	91·5
Castor oil ,, with minimum of S_2Cl_2 .	4·82	6·70	...	...	85·35	35·2	...	5·32	Trace	136·2 147·4 152·1
Castor oil ,, ,, maximum ,, ,, . .	10·60	8·95	...	...	...	21·9	105·6	...	0·26	105·6
Commercial Products.										
White substitute, No. 1	6·4	5·0	0·85	0·8	90·45	30·9	...	6·12	0·83	91·3
,, ,, No. 2	6·17	5·86	1·0	5·51	73·58	31·0	...	6·45	0·43	91·2
,, ,, No. 3	8·25	8·88	...	...	...	32·6	...	8·15	...	102·3
Brown substitute, No. 1	15·48	0·7	...	...	...	42·0	...	14·14	...	129·0
,, ,, No. 2	17·71	0·36	...	...	...	42·0	...	15·20	...	125·6

6. CANDLE-MAKING

TABLE NO. 45

Milk of Lime in Degrees Baumé obtained from 1 Kilogram Caustic Lime

1 Kilogram Caustic Lime yields Milk of Lime of		Weight of Milk of Lime.	1 Kilogram Caustic Lime yields Milk of Lime of		Weight of Milk of Lime.
Degrees Baumé.	Liter.	Kilograms.	Degrees Baumé.	Liter.	Kilograms.
10	7·50	9·44	38	3·39	5·07
11	7·10	9·01	39	3·37	5·05
12	6·70	8·60	40	3·35	5·03
13	6·30	8·20	41	3·34	5·01
14	5·88	7·80	42	3·32	5·00
15	5·50	7·43	43	3·31	4·98
16	5·25	7·16	44	3·30	4·96
17	5·01	6·92	45	3·29	4·95
18	4·80	6·70	46	3·28	4·93
19	4·68	6·51	47	3·27	4·92
20	4·42	6·38	48	3·26	4·90
21	4·24	6·18	49	3·25	4·89
22	4·16	6·05	50	3·24	4·88
23	4·05	5·92	51	3·23	4·87
24	3·95	5·81	52	3·220	4·86
25	3·87	5·72	53	3·215	4·85
26	3·81	5·63	54	3·210	4·84
27	3·75	5·56	55	3·205	4·83
28	3·70	5·49	56	3·200	4·82
29	3·65	5·43	57	3·195	4·81
30	3·60	5·36	58	3·190	4·800
31	3·56	5·31	59	3·185	4·795
32	3·52	5·27	60	3·180	4·790
33	3·49	5·22	61	3·175	4·780
34	3·47	5·19	62	3·170	4·775
35	3·45	5·16	63	3·165	4·770
36	3·43	5·13	64	3·160	4·760
37	3·41	5·10	65	3·150	4·750

TABLE NO. 46.—*Percentages of Caustic Lime in Milk of Lime*

Degrees Baumé.	Per cent.	100 Liter contain Kilograms CaO.	Degrees Baumé.	Per cent.	100 Liter contain Kilograms CaO.
10	10·60	13·3	38	19·72	29·5
11	11·12	14·2	39	19·80	29·6
12	11·65	15.2	40	19·88	29·8
13	12·16	16·1	41	19·95	29·9
14	12·68	17·0	42	20·03	30·1
15	13·20	18·0	43	20·10	30·2
16	13·72	18·9	44	20·16	30·3
17	14·25	19·8	45	20·22	30·4
18	14·77	20·7	46	20·27	30·5
19	15·23	21·6	47	20·32	30·6
20	15·68	22·4	48	20·37	30·7
21	16·10	23·3	49	20·43	30·7
22	16·52	24·0	50	20·48	30·8
23	16·90	24·7	51	20·53	30·9
24	17·23	25·3	52	20·57	31·0
25	17·52	25·8	53	20·62	31·1
26	17·78	26·3	54	20·66	31·1
27	18·04	26·7	55	20·70	31·2
28	18·26	27·0	56	20·74	31·3
29	18·46	27·4	57	20·78	31·3
30	18·67	27·7	58	20·82	31·4
31	18·86	27·9	59	20·85	31·4
32	19·02	28·2	60	20·89	31·5
33	19·17	28·4	61	20·93	31·5
34	19·31	28·7	62	20·97	31·6
35	19·43	28·9	63	21·00	31·6
36	19·53	29·1	64	21·03	31·7
37	19·63	29·3	65	21·05	31·7

TABLE NO. 47.—*Sulphuric Acid required to saturate* 100 *Kilograms of Lime*

Degrees Beaumé.	Containing Acid of 66° Beaumé. Per cent.	Kilograms Acid required for 100 Kilograms CaO.	Kilograms Water to be added to 100 Kilograms Acid to obtain Acid of Degrees Baumé.				
			5° B.	10° B.	15° B.	20° B.	25° B.
66	100·0	175·0	2477	1318	831	554	400
65	97·04	180·3	2471	1313	826	548	395
64	94·10	186·0	2465	1303	820	543	389
63	91·16	196·5	2455	1297	810	532	380
62	88·22	198·4	2451	1294	807	529	376
61	85·28	205·2	2446	1288	801	525	370
60	82·24	212·5	2439	1280	794	516	362
59	80·72	216·8	2434	1276	789	512	358
58	79·12	221·2	2430	1272	785	508	354
57	77·52	226·0	2425	1267	780	503	349
56	75·92	230·5	2421	1263	775	498	344
55	74·32	235·4	2416	1255	770	494	339
54	72·70	240·7	2411	1252	765	488	334
53	71·17	245·9	2405	1247	760	481	328
52	69·30	252·5	2399	1241	754	476	322
51	68·05	257·2	2494	1235	748	471	318
50	66·49	263·3	2386	1230	743	465	314
49	64·37	271·9	2379	1222	734	457	303
48	62·80	278·7	2372	1214	727	450	297
47	61·32	285·4	2366	1208	721	443	289
46	59·85	292·4	2359	1201	714	436	272
45	58·05	302·0	2349	1188	704	427	273

TABLE No. 48

Melting Points of Mixtures of Lauric Acid with Myristic, Palmitic, and Stearic Acids (Heintz)

Lauric Acid.	Myristic Acid.		Palmitic Acid.		Stearic Acid.	
Per cent.	Per cent.	Melting Point.	Per cent.	Melting Point.	Per cent.	Melting Point.
		°C.		°C.		°C.
100	0	43·6	0	43·6	0	43·6
90	10	41·3	10	41·5	10	41·5
80	20	38·5	20	37·1	20	38·5
70	30	35·1	30	38·3	30	43·4
60	40	36·7	40	40·1	40	50·8
50	50	37·4	50	47·0	50	55·8
40	60	43·0	60	51·2	60	59·0
30	70	46·7	70	54·5	70	62·0
20	80	49·6	80	57·4	80	64·7
10	90	51·8	90	59·8	90	67·0
0	100	53·8	100	62·0	100	69·2

TABLE No. 49

Melting Points of Mixtures of Myristic Acid with Palmitic and Stearic Acids (Heintz)

Myristic Acid.	Palmitic Acid.		Stearic Acid.	
Per cent.	Per cent.	Melting Point.	Per cent.	Melting Point.
		°C.		°C.
100	0	53·8	0	53·8
90	10	51·8	10	51·7
80	20	49·5	20	47·8
70	30	46·2	30	48·2
60	40	47·0	40	50·4
50	50	47·8	50	54·5
40	60	51·5	60	59·8
30	70	54·9	70	62·8
20	80	58·0	80	65·0
10	90	60·1	90	67·1
0	100	62·0	100	69·2

TABLE NO. 50

Melting Points of Mixtures of Palmitic Acid with Stearic Acid

Palmitic Acid.	Stearic Acid.	Melting Point.		
		Heintz.	Hehner and Mitchell.	De Visser.
Per cent.	Per cent.	°C.	°C.	°C.
100	0	62·0	61·8	62·618
90	10	60·1	59·0	59·31
85	15	...	...	57·80
80	20	57·5	56·5	56·53
75	25	...	...	55·46
71	29	...	...	54·92
70	30	55·1	54·2	54·85
68	32	...	...	55·12
67·5	32·5	55·2	54·5	
66	34	...	...	55·38
64	36	...	...	55·62
63	37	...	...	55·75
62	38	...	...	55·88
61	39	...	...	56·00
60	40	56·3	55·5	56·11
59	41	...	...	56·19
58	42	...	...	56·25
57	43	...	...	56·31
56	44	...	...	56·36
55	45	...	...	56·38
54	46	...	...	56·39
53	47	...	...	56·40
52	48	...	...	56·40
51	49	...	...	56·41
50	50	56·5	55·6	56·42
49	51	...	...	56·44
48	52	...	...	56·50
47	53	...	...	56·63
46	54	...	...	56·85
45	55	...	...	57·20
40	60	60·3	59·4	58·76
30	70	62·9	61·5	61·73
20	80	65·3	64·2	64·51
10	90	67·2	66·5	67·02
0	100	69·2	68·5	69·32

TABLE No. 51.—*Acid Values and Mean Molecular Weights of Mixtures of Stearic and Palmitic Acids*

Acid Value. Mgrms. of KOH per 1 grm.	Mean Molecular Weight.	100 parts of the mixture contain	
		Stearic Acid.	Palmitic Acid.
197·5	284·0	100	—
198·5	282·6	95	5
199·5	281·2	90	10
200·5	279·8	85	15
201·5	278·4	80	20
202·5	277·0	75	25
203·5	275·6	70	30
204·6	274·2	65	35
205·6	272·8	60	40
206·7	271·4	55	45
207·77	270·0	50	50
208·86	268·6	45	55
209·95	267·2	40	60
211·06	265·8	35	65
212·18	264·4	30	70
213·30	263·0	25	75
214·45	261·6	20	80
215·60	260·2	15	85
216·77	258·8	10	90
217·95	257·4	5	95
219·13	256·0	—	100

TABLE No. 52.—*Solidifying Points of Mixtures of Commercial Stearic and Oleic Acids* (Dalican)

Solidifying Point.	Commercial Stearic Acid.	Oleic Acid.	Solidifying Point.	Commercial Stearic Acid.	Oleic Acid.
C.	Per cent.	Per cent.	C.	Per cent.	Per cent.
35	25·20	69·80	44	47·50	47·50
35·5	26·40	68·60	44·5	49·40	45·60
36	27·30	67·70	45	51·30	43·70
36·5	28·75	66·25	45·5	52·25	42·75
37	29·80	65·20	46	53·20	41·80
37·5	30·60	64·40	46·5	55·10	39·90
38	31·25	63·75	47	57·95	37·05
38·5	32·15	62·85	47·5	58·90	36·10
39	33·44	61·55	48	61·75	33·25
39·5	34·30	60·80	48·5	66·50	28·50
40	35·15	59·85	49	71·25	23·75
40·5	36·10	58·90	49·5	72·20	22·80
41	38·00	57·00	50	75·05	19·95
41·5	38·95	56·05	50·5	77·10	17·90
42	39·90	55·10	51	79·50	15·50
42·5	42·75	52·27	51·5	81·90	13·10
43	43·70	51·30	52	84·00	11·00
43·5	44·65	50·35	52·5	88·30	6·70
			53	92·10	2·90

TABLE NO. 53

Solidifying Points of "Stearines" obtained by the Acid Saponification Process (De Schepper and Geitel)

Solidifying Point.	Percentage of "Stearine" of Solidifying Point.							
	Palm Oil.				Tallow.			
°C.	48°	50°	52°	55·4°	48°	50°	52°	54·8°
5	...	...	...	...	...	...	...	...
10	4·2	3·6	3·3	2·6	3·2	2·7	2·3	2·1
15	10·2	9·8	7·8	6·6	7·5	6·6	5·7	4·8
20	17·4	15·0	14·4	11·0	13·0	11·4	9·7	8·2
25	26·2	22·4	19·3	16·2	19·2	17·0	14·8	12·6
30	34·0	30·5	26·6	22·3	27·9	23·2	21·4	18·3
35	45·6	40·8	35·8	29·8	39·5	34·5	30·2	25·8
36	48·5	43·2	38·0	31·8	42·5	36·9	32·5	27·6
37	51·8	45·5	40·3	33·6	46·0	40·0	34·9	29·6
38	55·5	48·8	42·6	35·8	49·5	42·6	37·5	32·0
39	59·2	51·8	45·6	38·2	53·2	45·8	40·3	34·3
40	63·0	55·2	48·6	40·6	57·8	49·6	43·5	37·0
41	66·6	58·7	52·0	43·0	62·2	53·5	47·0	40·0
42	70·5	62·2	55·2	45·5	66·6	57·6	50·5	42·9
43	74·8	66·0	58·8	48·5	71·8	62·0	54·0	46·0
44	79·2	70·2	62·0	51·4	77·0	66·2	58·4	49·8
45	84·0	74·5	66·0	54·3	81·8	71·0	62·6	53·0
46	89·4	78·8	69·8	57·8	87·5	75·8	67·0	56·8
47	94·3	83·0	74·0	61·0	93·3	80·9	71·5	60·8
48	100·0	88·0	78·6	65·0	100·0	87·2	76·6	65·0
49	...	94·2	83·5	69·1	...	93·0	84·7	69·5
50	...	100·0	89·0	73·4	...	100·0	87·0	74·5
51	...	...	94·5	78·0	...	...	93·5	79·8
52	...	...	100·0	82·8	...	...	100·0	84·8
53	...	...	...	87·6	...	...	...	90·1
54	...	...	...	92·2	...	...	...	95·3
55	...	...	...	97·5	...	...	(54·8)	100·0
55·4	...	...	...	100·0	...	...	...	...

TABLE No. 54.—*"Stearine" in Red Oils from the Acid Saponification Process*

Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.	Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.	Solidifying Point of the Mixture.	Stearine of Solidifying Point 48° C.
°C.	Per cent.	°C.	Per cent.	°C.	Per cent.
5·4	...	20	12·1	35	39·5
6	0·3	21	13·2	36	43·0
7	0·8	22	14·5	37	46·9
8	1·2	23	15·7	38	50·5
9	1·7	24	17·0	39	54·5
10	2·5	25	18·5	40	58·9
11	3·2	26	20·0	41	63·6
12	3·8	27	21·7	42	68·5
13	4·7	28	23·3	43	73·5
14	5·6	29	25·2	44	78·9
15	6·6	30	27·2	45	83·5
16	7·7	31	29·2	46	89·0
17	8·8	32	31·5	47	94·1
18	9·8	33	33·8	48	100·0
19	11·1	34	36·6		

TABLE No. 55.—*Percentages of Oleic Acid in Red Oils* (Mangold)

Iodine Value.	Product contains		Iodine Value.	Product contains		Iodine Value.	Product contains	
	Oleic Acid.	"Stearine."		Oleic Acid.	"Stearine."		Oleic Acid.	"Stearine."
	Per cent.	Per cent.		Per cent.	Per cent.		Per cent.	Per cent.
0	0	100	31	34·41	65·59	62	68·83	31·17
1	1·11	98·89	32	35·52	64·48	63	69·94	30·06
2	2·22	97·78	33	36·63	63·37	64	71·05	28·95
3	3·33	96·67	34	37·74	62·26	65	72·16	27·84
4	4·44	95·56	35	38·85	61·15	66	73·27	26·73
5	5·55	94·45	36	39·96	60·04	67	74·38	25·62
6	6·66	93·34	37	41·07	58·93	68	75·49	24·51
7	7·77	92·28	38	42·18	57·82	69	76·60	23·40
8	8·88	91·12	39	43·29	56·71	70	77·71	22·29
9	9·99	90·01	40	44·40	55·60	71	78·82	21·18
10	11·10	88·90	41	45·51	54·49	72	79·93	20·07
11	12·21	87·79	42	46·62	53·38	73	81·04	18·96
12	18·32	86·68	43	47·73	52·27	74	82·15	17·85
13	14·43	85·57	44	48·84	51·16	75	83·26	16·74
14	15·54	84·46	45	49·95	50·05	76	84·37	15·63
15	16·65	83·35	46	51·06	48·94	77	85·48	14·52
16	17·76	82·24	47	52·17	47·83	78	86·59	13·41
17	18·87	81·13	48	53·28	46·72	79	87·70	12·30
18	19·98	80·02	49	54·39	45·61	80	88·82	11·18
19	21·09	78·91	50	55·50	44·49	81	89·93	10·07
20	22·20	77·80	51	56·62	43·38	82	91·04	8·96
21	23·31	76·69	52	57·73	42·27	83	92·15	7·85
22	24·42	75·58	53	58·84	41·16	84	93·26	6·74
23	25·53	74·47	54	59·95	40·05	85	94·37	5·63
24	26·64	73·36	55	61·06	38·94	86	95·48	4·52
25	27·75	72·25	56	62·17	37·83	87	96·59	3·41
26	28·86	71·14	57	63·28	36·72	88	97·70	2·30
27	29·97	70·03	58	64·39	35·61	89	98·81	1·19
28	31·08	68·92	59	65·50	34·50	90·07	100	0
29	32·19	67·81	60	66·61	33·39			
30	33·30	66·70	61	67·72	32·28			

TABLE NO. 56

Melting Points of Mixtures of Palmitic and Cerotic Acids
(Lewkowitsch)

Palmitic Acid.	Cerotic Acid.	Melting Point.
Per cent.	Per cent.	°C.
100	0	60·0
90	10	56·0
85	15	56·5
75	25	60·5
60	40	65·5
50	50	68·6
40	60	70·0
0	100	78·5

TABLE NO. 57

Melting Points of Fractions Obtained from Scotch Paraffin Waxes

No. of Fraction.	Of Melting Point 126° F.	Of Melting Point 111° F.	Of Melting Point 102° F.
1	119·0	103·0	94·0
2	120·0	104·0	94·0
3	120·5	104·0	95·0
4	121·0	105·0	96·0
5	121·0	106·0	96·0
6	121·0	107·0	97·5
7	121·5	107·5	98·0
8	122·0	108·0	98·5
9	122·5	108·5	99·0
10	123·0	109·0	99·0
11	124·0	110·5	100·0
12	125·0	112·0	102·0
13	126·0	113·0	103·5
14	127·0	113·5	105·0
15	128·0	114·5	106·5
16	129·0	116·0	108·0
17	130·0	117·0	109·0
18	132·0	119·0	110·0
19	134·0	123·0	112·5
20	138·0	125·0	113·0

TABLE No. 58

Specific Gravity of Paraffin Waxes (Allen)

No.	Origin of Sample.	Specific Gravity.		Solidifying Point.
		Solid, at 15° C.	Liquid, at 99° C.	°C.
1	Shale oil . . .	0·8666	0·7481	44·0
2	,, ,, . . .	0·8961	0·7494	47·0
3	,, ,, . . .	0·9000	0·7517	52·0
4	,, ,, . . .	0·9111	0·7572	58·5
5	American petroleum	0·9083	0·7535	53·8
6	Ozokerit . . .	...	0·7531	61·5
7	Rangoon tar . .	0·8831	0·7571	49·0

TABLE No. 59

Specific Gravities of Melted Paraffin Waxes (I. I. Redwood)

°F. at which determined.	Melting Point 108° F.	Melting Point 114° F.	Melting Point 120·5° F.	Melting Point 122·25° F.	Melting Point 122·75° F.	Melting Point 128·25° F.	Melting Point 133·25° F.
160	0·77069	0·77193	0·77391	0·77079	0·77023	0·77573	0·77723
155	0·77119	0·77330	0·77531	0·77149	0·77163	0·77653	0·77853
150	0·77309	0·77473	0·77657	0·77319	0·77283	0·77803	0·78003
145	0·77509	0·77620	0·77777	0·77519	0·77463	0·77973	0·78153
140	0·77679	0·77763	0·77847	0·77689	0·77633	0·78133	0·78333
135	0·77899	0·77953	0·78147	0·77869	0·77843	0·78303	
130	0·78049	0·78113	0·78267	0·78029	0·77973		
125	0·78199	0·78343	0·78441				
120	0·78359	0·78473					
115	0·78529						

TABLE No. 60

Specific Gravities of Solid Paraffin Waxes at 60° *F.* (I. I. Redwood)

Melting Point 106° F.	Melting Point 111·5° F.	Melting Point 120·5° F.	Melting Point 122·25° F.	Melting Point 125·75° F.	Melting Point 131° F.
0·87525	0·88230	0·89895	0·90105	0·90350	0·90865

TABLE NO. 61

Solubility of Paraffin Wax

Solvent.	Grms. of Paraffin Wax dissolved by		Weight of Solvent required to dissolve completely 1 Part of Paraffin Wax.
	100 grms.	100 c.c.	Grs.
Carbon bisulphide	12·99	...	7·6
Petroleum ether, boiling up to 75° C.; spec. grav. = 0·7233	11·73	8·48	8·5
Oil of turpentine; spec. grav. = 0·857, boiling point 158°-166° C.	6·06	5·21	16·1
Cumene comm. boiling up to 160° C.; spec. grav. = 0·867	4·28	3·72	23·4
Cumene fract., 150°-160° C.; spec. grav. = 0·847	3·99	3·39	25·0
Xylene comm. B.P., 135°-143° C.; spec. grav. = 0·866	3·95	3·43	25·1
Xylene fract., 136°-138° C.; spec. grav. = 0·864	4·39	3·77	22·7
Toluene comm., 108°-110° C.; spec. grav. = 0·866	3·83	3·34	26·1
Toluene fract., 108·5°-109·5° C.; spec. grav. = 0·866	3·92	3·41	25·5
Chloroform	2·42	3·61	41·3
Benzene	1·99	1·75	50·3
Ethyl ether	1·95	...	50·8
Isobutyl alcohol, spec. grav. = 0·804	0·285	0·228	352·9
Acetone, 55·5°-56·5° C.; spec. grav. = 0·797	0·262	0·209	378·7
Ethyl acetate	0·238	...	419·0
Ethyl alcohol, 99·5° Tr.	0·219	...	453·6
Amyl alcohol, 127°-129° C.; spec. grav. = 0·813	0·202	0·164	495·3
Propionic acid	0·165	...	595·3
Propyl alcohol	0·141	...	709·4
Methyl alcohol, 65·5°-66·5° C.; spec. grav. = 0·798	0·071	0·056	1447·5
Methyl formate	0·060	...	1648·7
Glacial acetic acid	0·060	0·063	1668·6
Ethyl alcohol, 64·3° Tr.	0·046	...	2149·5
Acetic anhydride	0·025	...	3856·2
Formic acid (cryst.)	0·013	0·015	7689·2
Ethyl alcohol, 75° Tr.	0·0003	...	330000·0

TABLE No. 62

Melting Points of Candle Material from "Mixed Paraffin Wax (Scotch) and Stearine" (I. I. Redwood)

A

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	102	10	121	100
80	,,	20	,,	98·50
70	,,	30	,,	100·0
60	,,	40	,,	104·50
50	,,	50	,,	110·50
40	,,	60	,,	111·0
30	,,	70	,,	113·50
20	,,	80	,,	117·50
10	,,	90	,,	119·0

B

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	120	10	123	118
80	,,	20	,,	116·50
70	,,	30	,,	114
60	,,	40	,,	112
50	,,	50	,,	110
40	,,	60	,,	109
30	,,	70	,,	113
20	,,	80	,,	118·50
10	,,	90	,,	119·50

C

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	120·25	10	129·75	118·50
80	,,	20	,,	116·75
70	,,	30	,,	114·50
60	,,	40	,,	112·25
50	,,	50	,,	113
40	,,	60	,,	118·75
30	,,	70	,,	122
20	,,	80	,,	124·50
10	,,	90	,,	127

D

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	125	10	121	123
80	,,	20	,,	121
70	,,	30	,,	119
60	,,	40	,,	117·50
50	,,	50	,,	114
40	,,	60	,,	111
30	,,	70	,,	107
20	,,	80	,,	114
10	,,	90	,,	117

E

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	130	10	121	128
80	,,	20	,,	125·50
70	,,	30	,,	123
60	,,	40	,,	121
50	,,	50	,,	118·50
40	,,	60	,,	114
30	,,	70	,,	109
20	,,	80	,,	115·50
10	,,	90	,,	118

F

Paraffin Wax.		Stearine.		Mixture.
Per cent.	Melting Point.	Per cent.	Melting Point.	Melting Point.
	°F.		°F.	°F.
90	132·50	10	129·75	130·50
80	,,	20	,,	128·50
70	,,	30	,,	126·50
60	,,	40	,,	124·25
50	,,	50	,,	121·0
40	,,	60	,,	117·75
30	,,	70	,,	119·50
20	,,	80	,,	125·25
10	,,	90	,,	127·50

TABLE No. 63

Melting Points of Candle Material from mixed Paraffin Wax (Thuringian) and "Stearine" (Scheithauer)

Paraffin Wax.	Of Melting Point.	"Stearine" Acid of Melting Point 54° C.	Melting Point of Mixture.
Per cent.	°C.	Per cent.	°C.
90·0	36·5	10·0	36·5
66·6	,,	33·3	39·0
33·3	,,	66·6	45·75
10·0	,,	90·0	51·75
90·0	37·5	10·0	36·5
66·6	,,	33·3	35·5
33·3	,,	66·6	47·0
10·0	,,	90·0	52·0
90·0	40·75	10·0	39·75
66·6	,,	33·3	40·50
33·3	,,	66·6	47·50
10·0	,,	90·0	52·0
90·0	45·0	10·0	44·0
66·6	,,	33·3	40·75
33·3	,,	66·6	48·0
10·0	,,	90·0	52·5
90·0	48·5	10·0	47·5
66·6	,,	33·3	45·0
33·3	,,	66·6	47·75
10·0	,,	90·0	52·50
90·0	50·0	10·0	49·0
66·6	,,	33·3	47·0
33·3	,,	66·6	47·5
10·0	,,	90·0	52·5
90·0	54·0	10·0	53·0
66·6	,,	33·3	49·0
33·3	,,	66·6	47·0
10·0	,,	90·0	52·5
90·0	56·5	10·0	55·5
66·6	,,	33·3	52·0
33·3	,,	66·6	47·5
10·0	,,	90·0	52·5

TABLE NO. 64

Mixed Ceresine and Beeswax Candle Material

Yellow Beeswax.	Yellow Ceresine.	Specific Gravity of the Mixture.	White Beeswax.	White Ceresine.	Specific Gravity of the Mixture.
100	0	0·963	100	0	0·973
90	10	0·961	90	10	0·968
80	20	0·9575	80	20	0·962
70	30	0·953	70	30	0·956
60	40	0·950	60	40	0·954
50	50	0·944	50	50	0·946
40	60	0·937	40	60	0·938
30	70	0·933	30	70	0·934
20	80	0·931	20	80	0·932
10	90	0·929	10	90	0·930
0	100	0·922	0	100	0·918

TABLE NO. 65

Mixed Ceresine and Paraffin Wax Candle Material (Berlinerblau)

Ceresine.	Paraffin Wax.	Melting Point.	Solidifying Point.	Specific Gravity at		
				15° C.	83°-85° C.	95° C.
Per cent.	Per cent.	°C.	°C.			
100	0	70-73	69·5	0·921	0·7835	0·774
95	5	69-73	68·5	0·919		
90	10	68-72	66·5	0·9175	0·7800	
80	20	66-71·5	65·0	0·914	0·7775	
70	30	64·5-70	63·0	0·910	0·7750	
60	40	62-69	62·0	0·907		
50	50	58·5-67	60·0	0·904	0·7705	
40	60	56·5-65	59·0	0·900		
30	70	54·5-62	57·0	0·897		
20	80	52·5-58·5	54·0	0·894		
10	90	49·5-54·5	49·0	0·892		
0	100	47-52	47·0	0·889	0·7655	0·756

TABLE No. 66.—*Commercial Oleines (Oleic Acids)*

Commercial Oleine from	Condition.	Colour.	Specific Gravity at 15·5° C.	Free Fatty Acids.	Unsaponifiable.	Neutral Fat.		Iodine Value.
						Direct.	By Difference.	
				Per cent.	Per cent.	Per cent	Per cent.	
Tallow by autoclave process . . .	Clear	Pale brown	0·8996	96·3	1·3	...	2·5	...
,, ,, ,, . . .	Fluid, with slight deposit	Brown	0·9055	80·3	2·2	...	17·5	...
,, ,, ,, . . .	,, ,, ,,	Dark brown	...	88·2	...	11·5	...	...
Tallow and palm oil (Belgian) . . .	Clear	,,	...	86·6	...	14·0	...	...
,, (?) ,, . . .	,,	Pale brown	...	93·8	3·9	...	2·3	...
,, (?) ,, . . .	Semi-solid	Brown	0·9085	83·7	2·9	13·4	17·0	...
Autoclave oleine ,, . . .	,,	Pale brown	0·9014	96·2	4·8	...	...	...
,, ,, French	Contained much solid	,,	0·8987	84·5	10·3	3·3	2·0	...
Tallow by lime saponification . . .	...	...	...	89·4	2·0	...	8·6	...
Tallow and palm oil by acid saponification	Clear	Pale brown	...	92·2	3·2	...	5·6	...
Tallow and palm oil by acid saponification	Solid at 15° C.	White	...	97·8	1·0	...	1·2	...
Tallow and palm oil by lime saponification	Clear	Pale brown	...	94·6	2·6	3·4	...	...
Tallow by autoclave process . . .	,,	,,	...	...	...	...	...	80

7. SOAP MANUFACTURE

TABLE NO. 67

Percentages of Caustic Soda and Caustic Potash in Caustic Lyes

Degrees Twaddell.	Specific Gravity.	Na_2O. Per cent.	NaOH. Per cent.	K_2O. Per cent.	KOH. Per cent.
0·7	1·0035	0·23	0·30	0·35	0·45
1·4	1·0070	0·47	0·61	0·70	0·90
2·1	1·0105	0·70	0·90	1·05	1·30
2·8	1·0141	0·93	1·20	1·40	1·70
3·6	1·0177	1·26	1·60	1·80	2·15
4·4	1·0213	1·55	2·00	2·20	2·60
5·1	1·0249	1·83	2·36	2·55	3·05
5·8	1·0286	2·10	2·71	2·90	3·50
6·6	1·0323	2·35	3·03	3·35	4·00
7·4	1·0360	2·60	3·35	3·80	4·50
8·2	1·0397	2·85	3·67	4·25	5·05
9·0	1·0435	3·10	4·00	4·70	5·60
9·7	1·0473	3·35	4·32	5·05	6·00
10·4	1·0511	3·60	4·64	5·40	6·40
11·2	1·0549	3·85	4·96	5·80	6·80
12·0	1·0588	4·10	5·29	6·20	7·40
12·7	1·0627	4·32	5·58	6·55	7·80
13·4	1·0667	4·55	5·87	6·90	8·20
14·2	1·0706	4·82	6·21	7·30	8·70
15·0	1·0746	5·08	6·55	7·70	9·20
15·8	1·0787	5·37	6·76	8·10	9·65
16·6	1·0827	5·67	7·31	8·50	10·10
17·3	1·0868	5·84	7·66	8·85	10·50
18·2	1·0909	6·20	8·00	9·20	10·90
19·1	1·0951	6·46	8·34	9·65	11·45
20·0	1·1000	6·73	8·68	10·10	12·00
20·8	1·1035	7·06	9·05	10·45	12·45
21·6	1·1077	7·30	9·42	10·80	12·90
22·4	1·1120	7·55	9·74	11·25	13·35
23·2	1·1163	7·80	10·06	11·60	13·80
24·1	1·1206	8·65	10·51	12·00	14·30
25·0	1·1250	8·50	10·97	12·40	14·80
25·9	1·1294	8·84	11·42	12·80	15·25
26·8	1·1339	9·18	11·84	13·20	15·70
27·6	1·1383	9·49	12·24	13·55	16·10
28·4	1·1423	9·80	12·64	13·90	16·50
29·4	1·1474	10·15	13·00	14·35	17·15
30·4	1·1520	10·50	13·55	14·80	17·60
31·4	1·1566	10·82	13·86	15·20	18·10
32·4	1·1613	11·14	14·37	15·60	18·60
33·6	1·1660	11·43	14·75	16·00	19·05
34·2	1·1707	11·73	15·13	16·40	19·50
35·1	1·1755	12·03	15·50	16·80	20·00
36·0	1·1803	12·33	15·91	17·20	20·50
37·0	1·1852	12·66	16·38	17·60	20·95
38·0	1·1901	13·00	16·77	18·00	21·40
39·0	1·1950	13·35	17·22	18·40	21·90
40·0	1·2000	13·70	17·67	18·80	22·50
41·0	1·2050	14·05	18·12	19·20	22·85
42·0	1·2101	14·40	18·58	19·60	23·30
43·0	1·2152	14·74	19·08	19·95	23·75

TABLE No. 67—*continued*

Percentages of Caustic Soda and Caustic Potash in Caustic Lyes

Degrees Twaddell.	Specific Gravity.	Na_2O. Per cent.	NaOH. Per cent.	K_2O. Per cent.	KOH. Per cent.
44·0	1·2202	15·18	19·58	20·30	24·20
45·1	1·2255	15·57	20·08	20·70	24·65
46·2	1·2308	15·96	20·59	21·10	25·10
47·1	1·2361	16·36	21·00	21·50	25·60
48·2	1·2414	16·76	21·42	21·90	26·10
49·3	1·2468	17·18	22·03	22·30	26·50
50·4	1·2522	17·55	22·64	22·70	27·00
51·5	1·2576	17·85	23·15	23·10	27·50
52·6	1·2632	18·35	23·67	23·50	28·00
53·7	1·2687	18·78	24·24	23·85	28·45
54·8	1·2743	19·23	24·81	24·20	28·90
55·9	1·2800	19·61	25·30	24·60	29·35
57·0	1·2857	20·00	25·80	25·00	29·80
58·2	1·2905	20·40	26·31	25·40	30·25
59·4	1·2973	20·80	26·83	25·80	30·70
60·5	1·3032	21·02	27·31	26·25	31·25
61·6	1·3091	21·55	27·80	26·70	31·80
62·8	1·3151	21·95	28·31	27·10	32·25
64·0	1·3211	22·35	28·83	27·50	32·70
65·2	1·3272	23·67	29·38	27·90	33·20
66·4	1·3333	23·20	29·93	28·30	33·70
67·7	1·3395	23·75	30·57	28·80	34·30
69·0	1·3458	24·20	31·22	29·30	34·90
70·2	1·3521	24·68	31·85	29·75	35·40
71·4	1·3585	25·17	32·47	30·20	35·90
72·7	1·3649	25·68	33·08	30·60	36·40
74·0	1·3714	26·12	33·69	31·00	36·90
75·3	1·3780	26·61	34·38	31·40	37·35
76·6	1·3846	27·10	34·96	31·80	37·80
78·5	1·3913	27·60	35·65	32·25	38·35
79·4	1·3981	28·10	36·25	32·70	38·90
80·7	1·4049	28·58	36·86	33·10	39·40
83·0	1·4187	29·56	38·13	33·95	40·40
84·8	1·4267	30·08	38·80	34·40	40·90
86·2	1·4328	30·54	39·39	34·90	41·50
87·6	1·4400	31·00	39·99	35·40	42·10
89·0	1·4472	31·50	40·75	35·95	42·75
90·6	1·4545	32·10	41·41	36·50	43·40
92·2	1·4619	32·65	42·12	37·00	44·00
93·6	1·4694	33·20	42·83	37·50	44·60
95·1	1·4769	33·80	43·66	38·00	45·20
96·6	1·4845	34·40	44·38	38·50	45·80
98·1	1·4922	35·05	45·27	39·05	46·45
99·6	1·5000	35·70	46·15	39·60	47·10
101·2	1·5079	36·30	46·87	40·15	47·70
102·8	1·5158	36·90	47·60	40·60	48·30
104·4	1·5238	37·45	48·81	41·05	48·85
106·0	1·5319	38·00	49·02	41·50	49·40

TABLE No. 68, *see pages* 112–115.

TABLE No. 69

Caustic Alkali Solutions required to saponify Fats of Mean Molecular Weight 860 (*Tallow, Cottonseed Oil, Olive Oil, etc.*)

Weight of Fat in Tons.	Gallons of Solution.							
	20° Twaddell = S. G. 1·1.		40° Twaddell = S. G. 1·2.		60·0 Twaddell = S. G. 1·3.		71° Twaddell = S. G. 1·355.	
	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.
·05	16·37	16·60	7·37	8·12	4·45	5·43	3·57	4·52
·1	32·74	33·21	14·74	16·24	8·90	10·87	7·15	9·04
·15	49·10	49·81	22·11	24·35	13·36	16·30	10·72	13·56
·2	65·47	66·42	29·48	32·47	17·81	21·73	14·30	18·08
·25	81·84	83·02	36·85	40·59	22·26	27·17	17·87	22·60
·3	98·21	99·63	44·22	48·71	26·71	32·60	21·44	27·12
·35	114·57	116·23	51·59	56·82	31·17	38·03	25·02	31·64
·4	130·94	132·84	58·96	64·94	35·62	43·47	28·59	36·16
·45	147·31	149·44	66·33	73·06	40·07	48·90	32·17	40·68
·5	163·68	166·05	73·70	81·18	44·52	54·33	35·74	45·20
·55	180·04	182·65	81·07	89·30	48·98	59·77	39·31	49·72
·6	196·41	199·26	88·44	97·41	53·43	65·20	42·89	54·24
·65	212·78	215·86	95·81	105·53	57·88	70·63	46·46	58·75
·7	229·15	232·47	103·18	113·65	62·33	76·07	50·04	63·27
·75	245·52	249·07	110·55	121·77	66·79	81·50	53·61	67·79
·8	261·88	265·67	117·92	129·88	71·24	86·94	57·18	72·31
·85	278·25	282·28	125·29	138·00	75·69	92·37	60·76	76·83
·9	294·62	298·88	132·66	146·12	80·14	97·80	64·33	81·35
·95	310·99	315·49	140·03	154·24	84·60	103·24	67·91	85·87
1·0	327·35	332·09	147·41	162·36	89·05	108·67	71·48	90·39
2·0	654·71	664·19	294·81	324·71	178·10	217·34	142·96	180·78
3·0	982·06	996·28	442·22	487·07	267·14	326·01	214·44	271·18
4·0	1309·42	1328·37	589·62	649·42	356·19	434·68	285·92	361·57
5·0	1636·77	1660·47	737·03	811·78	445·24	543·35	357·41	451·96
6·0	1964·12	1992·56	884·43	974·14	534·29	652·01	428·89	542·35
7·0	2291·48	2324·65	1031·84	1136·49	623·34	760·68	500·37	632·74
8·0	2618·83	2656·74	1179·24	1298·85	712·38	869·35	571·85	732·14
9·0	2946·19	2988·84	1326·65	1461·20	801·43	978·02	643·33	813·53
10·0	3273·54	3320·93	1474·05	1623·56	890·48	1086·69	714·81	903·92

TABL

Influence of Temperatures on the Specif

		0° C.	5° C.	10° C.	15° C.	20° C.	25° C.	30° C.	35° C.	40° C.	45° C.
1	Spec. Grav. .	1·367	1·364	1·362	1·360	1·357	1·355	1·353	1·350	1·348	1·345
2	Baumé . .	38·8	38·5	38·4	38·2	38·0	37·8	37·7	37·4	37·3	37·0
3	Spec. Grav. .	1·357	1·354	1·352	1·350	1·347	1·345	1·343	1·340	1·337	1·335
4	Baumé . .	38·0	37·8	37·6	37·4	37·2	37·0	36·9	36·6	36·4	36·2
5	Spec. Grav. .	1·347	1·344	1·342	1·340	1·338	1·336	1·333	1·330	1·327	1·325
6	Baumé . .	37·2	36·9	36·8	36·6	36·5	36·3	36·1	35·8	35·6	35·4
7	Spec. Grav. .	1·338	1·335	1·332	1·330	1·328	1·325	1·323	1·320	1·317	1·315
8	Baumé . .	36·5	36·2	36·0	35·8	35·8	35·4	35·3	35·0	34·8	34·6
9	Spec. Grav. .	1·328	1·325	1·322	1·320	1·318	1·315	1·313	1·310	1·307	1·305
10	Baumé . .	35·7	35·4	35·2	35·0	34·8	34·6	34·4	34·2	33·9	33·7
11	Spec. Grav. .	1·318	1·315	1·313	1·310	1·308	1·305	1·303	1·300	1·297	1·294
12	Baumé . .	34·8	34·6	34·4	34·2	34·0	33·7	33·5	33·3	33·0	32·8
13	Spec. Grav. .	1·308	1·305	1·303	1·300	1·297	1·294	1·292	1·289	1·287	1·284
14	Baumé . .	34·0	33·7	33·5	33·3	33·0	32·8	32·6	32·3	32·2	31·9
15	Spec. Grav. .	1·298	1·295	1·293	1·290	1·287	1·284	1·282	1·279	1·277	1·274
16	Baumé . .	33·1	32·8	32·7	32·4	32·2	31·9	31·7	31·5	31·3	31·0
17	Spec. Grav. .	1·288	1·285	1·283	1·280	1·277	1·274	1·272	1·269	1·267	1·264
18	Baumé . .	32·3	32·0	31·8	31·5	31·3	31·0	30·8	30·5	30·4	30·1
19	Spec. Grav. .	1·278	1·275	1·273	1·270	1·267	1·265	1·262	1·260	1·258	1·255
20	Baumé . .	31·4	31·1	30·9	30·6	30·4	30·2	29·9	29·7	29·5	29·3
21	Spec. Grav. .	1·268	1·265	1·263	1·260	1·257	1·255	1·252	1·250	1·248	1·245
22	Baumé . .	30·5	30·2	30·0	29·7	29·5	29·3	29·0	28·8	28·6	28·4
23	Spec. Grav. .	1·257	1·255	1·252	1·250	1·247	1·245	1·242	1·240	1·238	1·235
24	Baumé . .	29·5	29·3	29·0	28·8	28·5	28·4	28·1	27·9	27·7	27·4
25	Spec. Grav. .	1·247	1·245	1·242	1·240	1·237	1·235	1·232	1·230	1·228	1·225
26	Baumé . .	28·5	28·4	28·1	27·9	27·6	27·4	27·1	26·9	26·7	26·5
27	Spec. Grav. .	1·237	1·235	1·232	1·230	1·227	1·224	1·222	1·220	1·218	1·215
28	Baumé . .	27·6	27·4	27·1	26·9	26·6	26·4	26·2	26·0	25·8	25·5
29	Spec. Grav. .	1·227	1·225	1·222	1·220	1·217	1·214	1·212	1·210	1·208	1·205
30	Baumé . .	26·6	26·5	26·2	26·0	25·7	25·4	25·2	25·0	24·8	24·5
31	Spec. Grav. .	1·217	1·215	1·212	1·210	1·207	1·204	1·203	1·200	1·198	1·195
32	Baumé . .	25·7	25·5	25·2	25·0	24·7	24·4	24·3	24·0	23·8	23·5
33	Spec. Grav. .	1·207	1·205	1·202	1·200	1·197	1·195	1·193	1·190	1·188	1·185
34	Baumé . .	24·7	24·5	24·2	24·0	23·7	23·5	23·3	23·0	22·8	22·6
35	Spec. Grav. .	1·197	1·195	1·192	1·190	1·187	1·185	1·183	1·180	1·178	1·175
36	Baumé . .	23·7	23·5	23·2	23·0	22·7	22·5	22·3	22·0	21·8	21·6
37	Spec. Grav. .	1·187	1·185	1·182	1·180	1·177	1·175	1·173	1·170	1·168	1·165
38	Baumé . .	22·7	22·5	22·2	22·0	21·7	21·4	21·2	20·9	20·7	20·4
39	Spec. Grav. .	1·176	1·174	1·172	1·170	1·167	1·165	1·163	1·161	1·158	1·156
40	Baumé . .	21·6	21·3	21·1	20·9	20·5	20·3	20·1	19·9	19·6	19·4
41	Spec. Grav. .	1·166	1·164	1·162	1·160	1·157	1·155	1·153	1·151	1·148	1·146
42	Baumé . .	20·4	20·2	20·0	19·8	19·5	19·3	19·1	18·9	18·6	18·4
43	Spec. Grav. .	1·156	1·154	1·152	1·150	1·148	1·146	1·144	1·142	1·140	1·138
44	Baumé . .	19·4	19·2	19·0	18·8	18·6	18·4	18·2	18·0	17·8	17·4

[O. 68

ravities of Solutions of Caustic Soda

50° C.	55° C.	60° C.	65° C.	70° C.	75° C.	80° C.	85° C.	90° C.	95° C.	100° C.	
1·342	1·339	1·336	1·333	1·331	1·328	1·326	1·323	1·321	1·318	1·316	1
36·8	36·5	36·3	36·1	35·9	35·7	35·5	35·3	35·1	34·8	34·7	2
1·332	1·330	1·327	1·324	1·322	1·319	1·316	1·314	1·311	1·308	1·306	3
36·0	35·8	35·6	35·3	35·2	34·9	34·7	34·5	34·3	34·0	33·8	4
1·322	1·320	1·317	1·314	1·312	1·309	1·306	1·304	1·301	1·298	1·296	5
35·2	35·0	34·8	34·5	34·3	34·1	33·8	33·6	33·4	33·1	32·9	6
1·312	1·310	1·307	1·304	1·302	1·299	1·296	1·294	1·291	1·288	1·286	7
34·3	34·2	33·9	33·6	33·5	33·2	32·9	32·8	32·5	32·3	32·1	8
1·302	1·300	1·297	1·294	1·292	1·289	1·286	1·283	1·280	1·277	1·274	9
33·5	33·3	33·0	32·8	32·6	32·3	32·1	31·8	31·5	31·3	31·0	10
1·292	1·289	1·286	1·284	1·281	1·278	1·275	1·272	1·269	1·266	1·263	11
32·6	32·3	32·1	31·9	31·6	31·4	31·1	30·8	30·5	30·3	30·0	12
1·282	1·279	1·276	1·274	1·271	1·268	1·265	1 262	1·259	1·245	1·253	13
31·7	31·5	31·2	31·0	30·7	30·5	30·2	29·9	29·6	29·4	29·1	14
1·272	1·269	1·266	1·264	1·261	1·258	1·255	1·252	1·249	1·256	1·242	15
30·8	30·5	30·3	30·1	29·8	29·5	29·3	29·0	28·7	28·4	28·1	16
1·262	1·259	1·256	1·254	1·251	1·248	1·245	1·242	1·239	1·235	1·232	17
29·9	29·6	29·4	29·2	28·9	28·6	28·4	28·1	27·8	27·4	27·1	18
1·252	1·250	1·247	1·245	1·242	1·239	1·236	1·233	1·231	1·228	1·225	19
29·0	28·8	28·5	28·4	28·1	27·8	27·5	27·2	27·0	26·7	26·5	20
1·242	1·240	1·237	1·235	1·232	1·229	1·226	1·223	1·221	1·218	1·215	21
28·1	27·9	27·6	27·4	27·1	26·8	26·5	26·3	26·1	25·8	25·5	22
1·233	1·231	1·228	1·226	1·223	1·220	1·218	1·215	1·213	1·209	1·207	23
27·2	27·0	26·7	26·5	26·3	26·0	25·8	25·5	25·3	24·9	24·7	24
1·223	1·221	1·218	1·216	1·213	1·210	1·208	1·205	1·203	1·200	1·197	25
26·3	26·1	25·8	25·6	25·3	25·0	24·8	24·5	24·3	24·0	23·7	26
1·212	1·210	1·208	1·205	1·202	1·200	1·198	1·195	1·192	1·190	1·187	27
25·2	25·0	24·8	24·5	24·2	24·0	23·8	23·5	23·2	23·0	22·7	28
1·202	1·200	1·198	1·195	1·192	1·190	1·188	1·185	1·182	1·180	1·177	29
24·2	24·0	23·8	23·5	23·2	23·0	22·8	22·5	22·2	22·0	21·7	30
1·192	1·191	1·189	1·186	1·184	1·181	1·179	1·176	1·173	1·171	1·168	31
23·2	23·1	22·9	22·6	22·4	22·1	21·9	21·6	21·2	21·0	20·7	32
1·184	1·182	1·180	1·177	1·175	1·172	1·169	1·166	1·163	1·161	1·158	33
22·4	22·2	22·0	21·7	21·4	21·1	20·8	20·4	20·1	19·9	19·6	34
1·174	1·172	1·169	1·166	1·164	1·161	1·158	1·155	1·153	1·150	1·147	35
21·3	21·1	20·8	20·4	20·2	19·9	19·6	19·3	19·1	18·8	18·5	36
1·164	1·162	1·159	1·156	1·153	1·151	1·148	1·145	1·143	1·140	1·137	37
20·2	20·0	19·7	19·4	19·1	18·9	18·6	18·3	18·1	17·8	17·4	38
1·154	1·152	1·149	1·146	1·143	1·140	1·138	1·135	1·132	1·130	1·127	39
19·2	19·0	18·7	18·4	18·1	17·8	17·5	17·1	16·8	16·5	16·2	40
1·144	1·142	1·139	1·136	1·133	1·130	1·128	1·125	1·122	1·120	1·117	41
18·2	18·0	17·6	17·3	16·9	16·5	16·3	16·0	15·7	15·4	15·1	42
1·135	1·132	1·130	1·127	1·124	1·121	1·118	1·116	1·113	1·110	1·107	43
17·1	16·8	16·5	16·2	15·9	15·6	15·2	15·0	14·6	14·2	13·9	44

TABLE No. 68.

		0° C.	5° C.	10° C.	15° C.	20° C.	25° C.	30° C.	35° C.	40° C.	45° C.
1	Spec. Grav. .	1·146	1·144	1·142	1·140	1·138	1·136	1·134	1·132	1·130	1·127
2	Baumé . .	18·4	18·2	18·0	17·8	17·5	17·3	17·0	16·8	16·5	16·2
3	Spec. Grav. .	1·136	1·134	1·132	1·130	1·128	1·126	1·124	1·122	1·120	1·118
4	Baumé . .	17·3	17·0	16·8	16·5	16·3	16·1	15·9	15·7	15·5	15·2
5	Spec. Grav. .	1·126	1·124	1·122	1·120	1·118	1·116	1·114	1·112	1·110	1·108
6	Baumé . .	16·1	15·9	15·7	15·4	15·2	15·0	14·8	14·5	14·3	14·0
7	Spec. Grav. .	1·115	1·113	1·112	1·110	1·108	1·106	1·104	1·102	1·100	1·099
8	Baumé . .	14·9	14·6	14·5	14·3	14·0	13·8	13·5	13·2	13·0	12·9
9	Spec. Grav. .	1·105	1·103	1·102	1·100	1·098	1·096	1·095	1·093	1·092	1·090
10	Baumé . .	13·6	13·4	13·3	13·0	12·8	12·6	12·4	12·2	12·1	11·9
11	Spec. Grav. .	1·094	1·093	1·091	1·090	1·088	1·087	1·086	1·084	1·082	1·080
12	Baumé . .	12·3	12·2	12·0	11·9	11·6	11·5	11·4	11·1	10·9	10·6
13	Spec. Grav. .	1·084	1·083	1·081	1·080	1·078	1·077	1·076	1·074	1·072	1·070
14	Baumé . .	11·1	11·0	10·8	10·6	10·4	10·3	10·1	9·9	9·6	9·4
15	Spec. Grav. .	1·074	1·073	1·071	1·070	1·068	1·067	1·066	1·064	1·062	1·060
16	Baumé . .	9·9	9·8	9·5	9·4	9·1	9·0	8·9	8·6	8·3	8·0
17	Spec. Grav. .	1·064	1·063	1·061	1·060	1·058	1·057	1·056	1·054	1·052	1·050
18	Baumé . .	8·6	8·4	8·2	8·0	7·8	7·6	7·5	7·3	7·0	6·7
19	Spec. Grav. .	1·054	1·053	1·051	1·050	1·048	1·047	1·046	1·044	1·042	1·040
20	Baumé . .	7·3	7·1	6·9	6·7	6·4	6·3	6·2	5·9	5·6	5·4
21	Spec. Grav. .	1·044	1·043	1·041	1·040	1·038	1·037	1·036	1·034	1·032	1·030
22	Baumé . .	5·9	5·8	5·5	5·4	5·1	5·0	4·9	4·6	4·4	4·1
23	Spec. Grav. .	1·034	1·033	1·031	1·030	1·028	1·027	1·026	1·024	1·022	1·020
24	Baumé . .	4·6	4·5	4·3	4·1	3·9	3·7	3·5	3·3	3·0	2·8
25	Spec. Grav. .	1·024	1·023	1·021	1·020	1·018	1·017	1·016	1·014	1·012	1·010
26	Baumé . .	3·3	3·2	2·9	2·8	2·5	2·4	2·3	2·0	1·7	1·4
27	Spec. Grav. .	1·014	1·013	1·011	1·010	1·008	1·007	1·006	1·004	1·002	1·000
28	Baumé . .	2·0	1·9	1·6	1·4	1·1	1·0	0·9	0·6	0·3	

ntinued

50° C.	55° C.	60° C.	65° C.	70° C.	75° C.	80° C.	85° C.	90° C.	95° C.	100° C.	
1·125	1·122	1·120	1·117	1·114	1·111	1·108	1·106	1·103	1·100	1·097	1
16·0	15·7	15·4	15·1	14·8	14·4	14·0	13·8	13·4	13·0	12·7	2
1·116	1·113	1·110	1·107	1·104	1·101	1·099	1·096	1·093	1·090	1·087	3
15·0	14·6	14·3	13·9	13·5	13·1	12·9	12·6	12·2	11·9	11·5	4
1·106	1·103	1·100	1·097	1·094	1·092	1·089	1·086	1·083	1·080	1·077	5
13·8	13·4	13·0	12·7	12·3	12·1	11·8	11·4	11·0	10·6	10·3	6
1·097	1·094	1·091	1·089	1·086	1·083	1·080	1·077	1·074	1·071	1·068	7
12·7	12·3	12·0	11·8	11·4	11·0	10·6	10·3	9·9	9·5	9·1	8
1·087	1·084	1·082	1·079	1·076	1·073	1·070	1·067	1·064	1·061	1·058	9
11·5	11·1	10·9	10·5	10·1	9·8	9·4	9·0	8·6	8·2	7·8	10
1·078	1·075	1·073	1·070	1·067	1·064	1·061	1·058	1·056	1·052	1·048	11
10·4	10·0	9·8	9·4	9·0	8·6	8·2	7·8	7·5	7·0	6·4	12
1·068	1·066	1·063	1·060	1·057	1·054	1·051	1·048	1·046	1·043	1·040	13
9·1	8·9	8·4	8·0	7·6	7·3	6·9	6·4	6·2	5·8	5·4	14
1·058	1·056	1·053	1·050	1·047	1·044	1·042	1·039	1·036	1·033	1·030	15
7·8	7·5	7·1	6·7	6·3	5·9	5·6	5·2	4·9	4·5	4·0	16
1·048	1·046	1·043	1·040	1·037	1·034	1·032	1·029	1·026	1·023	1·020	17
6·4	6·2	5·8	5·4	5·0	4·5	4·4	4·0	3·6	3·2	2·8	18
1·038	1·036	1·033	1·030	1·027	1·024	1·021	1·019	1·016	1·013	1·010	19
5·1	4·9	4·5	4·1	3·7	3·3	2·9	2·6	2·3	1·9	1·4	20
1·028	1·026	1·023	1·020	1·017	1·014	1·011	1·009	1·006	1·003	1·000	21
3·9	3·6	3·1	2·8	2·4	2·0	1·6	1·3	0·9	0·4		22
1·018	1·016	1·013	1·010	1·007	1·004	1·001	0·999	0·996	0·993	0·990	23
2·5	2·2	1·9	1·4	1·0	0·6	0·1					24
1·008	1·006	1·003	1·000	0·997	0·994	0·991	0·989	0·986	0·983	0·980	25
1·1	0·9	0·4									26
0·998	0·996	0·993	0·990	0·987	0·984	0·981	0·979	0·976	0·973	0·970	27
											28

TABLE NO. 70

Caustic Alkali Solutions required to saponify Fats of Mean Molecular Weight 670 *(Cocoanut Oil, Palmkernel Oil)*

Weight of Fat in Tons.	Gallons of Solution.							
	20° Twaddell = S. G. 1·1.		40° Twaddell = S. G. 1·2.		60° Twaddell = S. G. 1·3.		71° Twaddell = S. G. 1·355.	
	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.	NaOH.	KOH.
·05	21·01	21·31	9·46	10·42	5·72	6·97	4·59	5·80
·1	42·02	42·63	18·92	20·84	11·43	13·95	9·18	11·60
·15	63·03	63·94	28·38	31·26	17·15	20·92	13·76	17·40
·2	84·04	85·25	37·84	41·68	22·86	27·90	18·35	23·21
·25	105·05	106·57	47·30	52·10	28·58	34·87	22·94	29·01
·3	126·06	127·88	56·76	62·52	34·29	41·85	27·53	34·81
·35	147·07	149·19	66·22	72·94	40·01	48·82	32·11	40·61
·4	168·07	170·51	75·68	83·36	45·72	55·79	36·70	46·41
·45	189·08	191·82	85·14	93·78	51·44	62·77	41·29	52·21
·5	210·09	213·13	94·60	104·20	57·15	69·74	45·88	58·01
·55	231·10	234·45	104·06	114·62	62·87	76·72	50·46	63·81
·6	252·11	255·76	113·52	125·04	68·58	83·69	55·05	69·62
·65	273·12	277·07	122·98	135·46	74·30	90·67	59·64	75·42
·7	294·13	298·39	132·44	145·88	80·01	97·64	64·23	81·22
·75	315·14	319·70	141·91	156·30	85·73	104·61	68·81	87·02
·8	336·15	341·01	151·37	166·72	91·44	111·59	73·40	92·82
·85	357·16	362·33	160·83	177·14	97·16	118·56	77·99	98·62
·9	378·17	383·64	170·29	187·56	102·87	125·54	82·58	104·42
·95	399·18	404·95	179·75	197·98	108·59	132·51	87·16	110·22
1·0	420·19	426·27	189·21	208·40	114·30	139·49	91·75	116·03
2·0	840·37	852·54	378·41	416·80	228·60	278·97	183·50	232·05
3·0	1260·56	1278·80	567·62	625·19	342·90	418·46	275·26	348·08
4·0	1680·74	1705·07	756·83	833·59	457·20	557·94	367·01	464·10
5·0	2100·93	2131·34	946·04	1041·99	571·50	697·43	458·76	580·13
6·0	2521·12	2557·61	1135·24	1250·39	685·80	836·92	550·51	696·16
7·0	2941·30	2983·88	1324·45	1458·79	800·10	976·40	642·26	812·18
8·0	3361·49	3410·14	1513·66	1667·18	914·40	1115·89	734·02	928·21
9·0	3781·67	3836·41	1702·86	1875·58	1028·70	1255·37	825·77	1044·23
10·0	4201·86	4262·68	1892·07	2083·98	1143·00	1394·86	917·52	1160·26

TABLE No. 71.—*German and French Alkalimetrical Degrees*

Real Soda.	German degrees.	French degrees.	Real Soda.	German degrees.	French degrees.
Na_2O. Per cent.	Na_2CO_3. Per cent.		Na_2O. Per cent.	Na_2CO_3. Per cent.	
0·5	0·85	0·79	27	46·17	42·67
1	1·81	1·58	27·5	47·02	43·46
1·5	2·56	2·37	28	47·88	44·25
2	3·42	3·16	28·5	48·73	45·04
2·5	4·27	3·95	29	49·59	45·83
3	5·13	4·74	29·5	50·44	46·62
3·5	5·98	5·53	30	51·29	47·42
4	6·84	6·32	30·5	52·14	48·21
4·5	7·69	7·11	31	53·00	49·00
5	8·55	7·90	31·5	53·85	49·79
5·5	9·40	8·69	32	54·71	50·88
6	10·26	9·48	32·5	55·56	51·37
6·5	11·11	10·27	33	56·42	52·16
7	11·97	11·06	33·5	57·27	52·95
7·5	12·82	11·85	34	58·13	53·74
8	13·68	12·64	34·5	58·98	54·53
8·5	14·53	13·43	35	59·84	55·32
9	15·39	14·22	35·5	60·69	56·11
9·5	16·24	15·01	36	61·55	56·90
10	17·10	15·81	36·5	62·40	57·69
10·5	17·95	16·60	37	63·26	58·48
11	18·81	17·39	37·5	64·11	59·27
11·5	19·66	18·18	38	64·97	60·06
12	20·52	18·97	38·5	65·82	60·85
12·5	21·37	19·76	39	66·68	61·64
13	22·23	21·55	39·5	67·53	62·43
13·5	23·08	21·34	40	68·39	63·22
14	23·94	22·13	40·5	69·24	64·01
14·5	24·79	22·92	41	70·10	64·81
15	25·65	23·71	41·5	70·95	65·60
15·5	26·50	24·50	42	71·81	66·39
16	27·36	25·29	42·5	72·66	67·18
16·5	28·21	26·08	43	73·52	67·97
17	29·07	26·87	43·5	74·37	68·76
17·5	29·92	27·66	44	75·23	69·55
18	30·78	28·45	44·5	76·08	70·34
18·5	31·63	29·24	45	76·94	71·13
19	32·49	30·03	45·5	77·80	71·92
19·5	33·34	30·82	46	78·66	72·71
20	34·20	31·61	46·5	79·51	73·50
20·5	35·05	32·40	47	80·37	74·29
21	35·91	33·19	47·5	75·08	75·08
21·5	36·76	33·98	48	82·07	75·87
22	37·62	34·77	48·5	82·93	76·66
22·5	38·47	35·56	49	83·78	77·45
23	39·33	36·35	49·5	84·64	78·24
23·5	40·18	37·14	50	85·48	79·03
24	41·04	37·93	50·5	86·34	79·82
24·5	41·89	38·72	51	87·19	80·61
25	42·75	39·51	51·5	88·05	81·40
25·5	43·60	40·30	52	88·90	82·19
26	44·46	41·09	52·5	89·76	82·98
26·5	45·31	41·88	53	90·61	83·77

TABLE No. 71—*continued.—German and French Alkalimetrical Degrees*

Real Soda.	German degrees.	French degrees.	Real Soda.	German degrees.	French degrees.
Na_2O.	Na_2CO_3.		Na_2O.	Na_2CO_3.	
53·5	91·47	84·56	66	112·85	104·32
54	92·32	85·35	66·5	113·70	105·11
54·5	93·18	86·14	67	114·56	105·90
55	94·03	86·93	67·5	115·41	106·69
55·5	94·89	87·72	68	116·27	107·48
56	95·74	88·52	68·5	117·12	108·27
56·5	96·60	89·31	69	117·98	109·06
57	97·45	90·10	69·5	118·83	109·85
57·5	98·31	90·88	70	119·69	110·64
58	99·16	91·68	70·5	120·53	111·43
58·5	100·02	92·47	71	121·39	112·23
59	100·87	93·26	71·5	122·24	113·02
59·5	101·73	94·05	72	123·10	113·81
60	102·58	94·84	72·5	123·95	114·60
60·5	103·44	95·63	73	124·81	115·39
61	104·30	96·42	73·5	125·66	116·18
61·5	105·15	97·21	74	126·52	116·97
62	106·01	98·00	74·5	127·37	117·76
62·5	106·86	98·79	75	128·23	118·55
63	107·72	99·58	75·5	129·08	119·34
63·5	108·57	100·37	76	129·94	120·13
64	109·43	101·16	76·5	130·79	120·92
64·5	110·28	101·95	77	131·65	121·71
65	111·14	102·74	77·5	132·50	122·50
65·5	111·99	103·53			

TABLE No. 72

Specific Gravities of Solutions of Sodium Carbonate at 15° *C.*

Twaddell.	Percentage by Weight.		Twaddell.	Percentage by Weight.	
	Na_2O.	Na_2CO_3.		Na_2O.	Na_2CO_3.
1	0·28	0·47	16	4·42	7·57
2	0·56	0·95	17	4·70	8·04
3	0·84	1·42	18	4·97	8·51
4	1·11	1·90	19	5·24	8·97
5	1·39	2·38	20	5·52	9·43
6	1·67	2·85	21	5·79	9·90
7	1·95	3·33	22	6·06	10·37
8	2·22	3·80	23	6·33	10·83
9	2·50	4·28	24	6·61	11·30
10	2·78	4·76	25	6·88	11·76
11	3·06	5·23	26	7·15	12·23
12	3·34	5·71	27	7·42	12·70
13	3·61	6·17	28	7·70	13·16
14	3·88	6·64	29	7·97	13·63
15	4·16	7·10	30	8·24	14·09

TABLE No. 73.—*Specific Gravities of Solutions of Potassium Carbonate at 15° C.* (Gerlach)

Twaddell.	Per cent by Weight. K_2CO_3.	Kilogrm. per cubic meter. K_2CO_3.	Lbs. per cubic foot. K_2CO_3.	Twaddell.	Per cent by Weight. K_2CO_3.	Kilogrm. per cubic meter. K_2CO_3.	Lbs. per cubic foot. K_2CO_3.
1	·54	5·4	0·34	58	29·02	374·3	23·34
2	1·08	10·9	0·68	59	29·46	381·5	23·79
3	1·62	16·4	1·02	60	29·91	388·8	24·24
4	2·16	22·0	1·37	61	30·34	395·9	24·68
5	2·70	27·7	1·73	62	30·77	403·1	25·13
6	3·24	33·4	2·08	63	31·21	410·3	25·58
7	3·78	39·1	2·43	64	31·64	417·6	26·04
8	4·32	44·9	2·80	65	32·08	425·0	26·50
9	4·86	50·8	3·17	66	32·51	432·4	26·96
10	5·40	56·7	3·53	67	32·94	439·8	27·42
11	5·94	62·7	3·90	68	33·38	447·3	27·89
12	6·48	68·7	4·28	69	33·81	454·8	28·36
13	7·02	74·8	4·66	70	34·25	462·4	28·83
14	7·56	80·9	5·04	71	34·67	469·9	29·30
15	8·10	87·1	5·43	72	35·10	477·4	29·77
16	8·64	93·3	5·82	73	35·52	484·9	30·23
17	9·18	99·6	6·21	74	35·95	492·5	30·71
18	9·72	105·9	6·60	75	36·37	500·1	31·18
19	10·26	108·4	6·51	76	36·80	507·8	31·66
20	10·80	118·8	7·41	77	37·22	515·6	32·15
21	11·31	125·0	7·79	78	37·65	523·3	32·63
22	11·82	131·2	8·18	79	38·07	531·7	33·11
23	12·33	137·5	8·57	80	38·50	539·0	33·60
24	12·84	143·8	8·97	81	38·91	546·7	34·09
25	13·35	150·2	9·37	82	39·32	554·4	34·57
26	13·86	156·6	9·76	83	39·73	562·2	35·05
27	14·37	163·1	10·17	84	40·14	570·0	35·54
28	14·88	169·6	10·57	85	40·55	577·8	36·02
29	15·39	176·2	10·99	86	40·96	585·7	36·51
30	15·90	182·8	11·40	87	41·37	593·6	37·01
31	16·38	189·2	11·80	88	41·78	601·6	37·51
32	16·86	195·6	12·20	89	42·19	609·6	38·01
33	17·34	202·0	12·59	90	42·60	617·7	38·51
34	17·82	208·5	13·00	91	43·00	625·6	39·01
35	18·30	215·0	13·40	92	43·40	633·6	39·51
36	18·78	221·6	13·82	93	43·80	641·6	40·01
37	19·26	228·2	14·23	·94	44·20	649·7	40·51
38	19·74	234·9	14·65	95	44·60	657·8	41·01
39	20·22	241·7	15·07	96	45·00	666·0	41·52
40	20·70	248·4	15·49	97	45·40	674·2	42·03
41	21·17	255·2	15·91	98	45·80	682·4	42·55
42	21·65	262·0	16·33	99	46·20	690·7	43·06
43	22·12	268·8	16·76	100	46·60	699·0	43·58
44	22·60	275·7	17·19	101	46·98	707·1	44·09
45	23·07	282·6	17·62	102	47·37	715·3	44·61
46	23·55	289·6	18·05	103	47·35	723·5	45·11
47	24·02	296·7	18·50	104	48·14	731·7	45·62
48	24·50	303·8	18·94	105	48·52	740·0	46·14
49	24·97	310·9	19·38	106	48·91	748·3	46·66
50	25·45	318·1	19·83	107	49·29	756·7	47·18
51	25·89	325·0	20·26	108	49·68	765·1	47·70
52	26·34	331·9	20·70	109	50·06	773·5	48·22
53	26·78	338·8	21·12	110	50·45	782·0	48·76
54	27·23	345·8	21·56	111	50·83	790·5	49·29
55	27·68	352·8	22·00	112	51·22	799·0	49·82
56	28·12	359·9	22·44	113	51·61	807·7	50·36
57	28·57	367·1	22·89	114	52·00	816·4	50·90

TABLE NO. 74

Determination of Resin in Soap by Twitchell's Method (Lewkowitsch)

A. *Volumetric Analysis*

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per cent.	Per cent.
1	9·79	9·98, 9·34, 9·79, 9·91.
2	19·69	23·97, 24·55, 22·93, 23·28, 23·98, 24·08.
3	21·45	24·96, 24·78, 23·63.
4	24·66	24·89, 25·15, 25·06, 24·23.
5	30·31	29·69, 30·12, 28·18, 29·78.
6	39·81	40·24, 40·37, 41·44, 42·13, 41·8, 40·37, 42·18, 40·55, 40·07, 40·05, 43·69, 41·12, 41·81, 40·77, 44·82.
7	45·05	45·76, 46·50, 49·61, 47·66, 46·45, 47·84, 45·34, 44·24, 44·48, 44·39.

B. *Gravimetric Analysis*

Mixed Fatty and Resin Acids.	Resin Acids.	
	Theory.	Experiment.
No.	Per cent.	Per cent.
1	9·79	9·38, 9·97.
2	19·69	20·46, 20·55, 19·96,[1] 19·99, 19·44, 19·33.
3	21·45	19·25, 18·27, 19·37, 17·83,[1] 19·54, 18·61, 18·57, 19·16.
4	24·66	20·97, 16·65, 21·76.
5	30·31	25·76, 25·06, 23·66, 26·10.
6	39·81	35·97, 38·86, 36·44, 36·14, 35·42, 35·86, 32·51, 36·29.
7	45·05	37·58, 37·23, 37·29, 36·97, 35·32, 40·06, 36·8.

[1] Emulsion.

8. GLYCERIN

TABLE NO. 75.—*Residue and Ash of Distilled Glycerines*

No.	Residue at 160° C.	Ash.	Organic Residue.	
	Per cent.	Per cent.	Per cent.	
1	0·03033	0·00603	0·0243	Chemically pure glycerin, B.P.
2	0·0276	0·00300	0·0246	,, ,,
3	0·0337	0·005	0·0327	,, ,,
4	0·0498	0·0138	0·0360	,, ,,
5	0·0452	0·0081	0·0371	,, ,,
6	0·0509	0·0066	0·0443	,, ,,
7	0·0656	0·0139	0·0517	,, ,,
8	0·0748	0·0140	0·0738	Commercial double distilled.
9	0·0905	0·0154	0·0751	,, ,,
10	0·1047	0·0190	0·0857	,, ,,
11	0·1236	0·0305	0·0931	,, ,,
12	0·1621	0·0183	0·1438	,, ,,
13	0·8060	0·2090	0·5970	Commercial distilled glycerin.

TABLE No. 76.—*Specific Gravities of Aqueous Solutions of Glycerin*

Glycerol. Per cent.	LENZ.	STROHMER.	GERLACH.		NICOL.
	Spec. Grav. at 12°-14° C. Water at 12° C. = 1.	Spec. Grav. at 17·5° C. Water at 17·5 C. = 1.	Spec. Grav. at 15° C. Water at 15° C. = 1.	Spec. Grav. at 20° C. Water at 20° C. = 1.	Spec. Grav. at 20° C. Water at 20° C. = 1.
100	1·2691	1·262	1·2653	1·2620	1·26348
99	1·2664	1·259	1·2628	1·2594	1·26091
98	1·2637	1·257	1·2602	1·2568	1·25832
97	1·2610	1·254	1·2577	1·2542	1·25572
96	1·2584	1·252	1·2552	1·2516	1·25312
95	1·2557	1·249	1·2526	1·2490	1·25052
94	1·2531	1·246	1·2501	1·2464	1·24790
93	1·2504	1·244	1·2476	1·2438	1·24526
92	1·2478	1·241	1·2451	1·2412	1·24259
91	1·2451	1·239	1·2425	1·2386	1·23990
90	1·2425	1·236	1·2400	1·2360	1·23720
89	1·2398	1·233	1·2373	1·2333	1·23449
88	1·2372	1·231	1·2346	1·2306	1·23178
87	1·2345	1·228	1·2319	1·2279	1·22907
86	1·2318	1·226	1·2292	1·2252	1·22636
85	1·2292	1·223	1·2265	1·2225	1·22365
84	1·2265	1·220	1·2238	1·2198	1·22094
83	1·2238	1·218	1·2211	1·2171	1·21823
82	1·2212	1·215	1·2184	1·2144	1·21552
81	1·2185	1·213	1·2157	1·2117	1·21281
80	1·2159	1·210	1·2130	1·2090	1·21010
79	1·2122	1·207	1·2102	1·2063	1·20739
78	1·2106	1·204	1·2074	1·2036	1·20468
77	1·2079	1·202	1·2046	1·2009	1·20197
76	1·2042	1·199	1·2018	1·1982	1·19925
75	1·2016	1·196	1·1990	1·1955	1·19653
74	1·1999	1·193	1·1962	1·1928	1·19381
73	1·1973	1·190	1·1934	1·1901	1·19109
72	1·1945	1·188	1·1906	1·1874	1·18837
71	1·1918	1·185	1·1878	1·1847	1·18565
70	1·1889	1·182	1·1850	1·1820	1·18293
69	1·1858	1·179	...	...	1·18020
68	1·1826	1·176	...	...	1·17747
67	1·1795	1·173	...	...	1·17474
66	1·1764	1·170	...	...	1·17201
65	1·1733	1·167	1·1711	1·1685	1·16928
64	1·1702	1·163	...	...	1·16654
63	1·1671	1·160	...	...	1·16380
62	1·1640	1·157	...	...	1·16107
61	1·1610	1·154	...	...	1·15834
60	1·1582	1·151	1·1570	1·1550	1·15561
59	1·1556	1·149	...	...	1·15288
58	1·1530	1·146	...	...	1·15015
57	1·1505	1·144	...	...	1·14742
56	1·1480	1·142	...	...	1·14469
55	1·1455	1·140	1·1430	1·1415	1·14196
54	1·1430	1·137	...	...	1·13923
53	1·1403	1·135	...	...	1·13650
52	1·1375	1·133	...	...	1·13377
51	1·1348	1·130	...	...	1·13104
50	1·1320	1·128	1·1290	1·1280	1·12831
45	1·1183	...	1·1155	1·1145	1·11469
40	1·1045	...	1·1020	1·1010	1·10118
35	1·0907	...	1·0885	1·0875	1·08786
30	1·0771	...	1·0750	1·0740	1·07469
25	1·0635	...	1·0620	1·0610	1·06166
20	1·0498	...	1·0490	1·0480	1·04884
15	1·0374	...	...	...	1·03622
10	1·0245	...	1·0245	1·0235	1·02391
5	1·0123	...	...	...	1·01184
0	1·0000	...	1·0000	1·0000	1·00000

TABLE NO. 77

Specific Gravities and Refractive Indices of Aqueous Solutions of Glycerin (Lenz)

Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12·5°-12·8° C.	Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12·5°-12·8° C.	Glycerol.	Sp. Gr. at 12°-14° C.	Ref. Ind. at 12·5°-12·8° C.
Per cent.			Per cent.			Per cent.		
100	1·2691	1·4758	66	1·1764	1·4249	32	1·0825	1·3745
99	1·2664	1·4744	65	1·1733	1·4231	31	1·0798	1·3732
98	1·2637	1·4729	64	1·1702	1·4213	30	1·0771	1·3719
97	1·2610	1·4715	63	1·1671	1·4195	29	1·0744	1·3706
96	1·2584	1·4700	62	1·1640	1·4176	28	1·0716	1·3692
95	1·2557	1·4686	61	1·1610	1·4158	27	1·0689	1·3679
94	1·2531	1·4671	60	1·1582	1·4140	26	1·0663	1·3666
93	1·2504	1·4657	59	1·1556	1·4126	25	1·0635	1·3652
92	1·2478	1·4642	58	1·1530	1·4114	24	1·0608	1·3639
91	1·2451	1·4628	57	1·1505	1·4102	23	1·0580	1·3626
90	1·2425	1·4613	56	1·1480	1·4091	22	1·0553	1·3612
89	1·2398	1·4598	55	1·1455	1·4079	21	1·0525	1·3599
88	1·2372	1·4584	54	1·1430	1·4065	20	1·0498	1·3585
87	1·2345	1·4569	53	1·1403	1·4051	19	1·0471	1·3572
86	1·2318	1·4555	52	1·1375	1·4036	18	1·0446	1·3559
85	1·2292	1·4540	51	1·1348	1·4022	17	1·0422	1·3546
84	1·2265	1·4525	50	1·1320	1·4007	16	1·0398	1·3533
83	1·2238	1·4511	49	1·1293	1·3993	15	1·0374	1·3520
82	1·2212	1·4496	48	1·1265	1·3979	14	1·0349	1·3507
81	1·2185	1·4482	47	1·1238	1·3964	13	1·0332	1·3494
80	1·2159	1·4467	46	1·1210	1·3950	12	1·0297	1·3480
79	1·2122	1·4453	45	1·1183	1·3935	11	1·0271	1·3467
78	1·2106	1·4438	44	1·1155	1·3921	10	1·0245	1·3454
77	1·2079	1·4424	43	1·1127	1·3906	9	1·0221	1·3442
76	1·2042	1·4409	42	1·1100	1·3890	8	1·0196	1·3430
75	1·2016	1·4395	41	1·1072	1·3875	7	1·0172	1·3417
74	1·1999	1·4380	40	1·1045	1·3860	6	1·0147	1·3405
73	1·1973	1·4366	39	1·1017	1·3844	5	1·0123	1·3392
72	1·1945	1·4352	38	1·0989	1·3829	4	1·0098	1·3380
71	1·1918	1·4337	37	1·0962	1·3813	3	1·0074	1·3367
70	1·1889	1·4321	36	1·0934	1·3798	2	1·0049	1·3355
69	1·1858	1·4304	35	1·0907	1·3785	1	1·0025	1·3342
68	1·1826	1·4286	34	1·0880	1·3772			
67	1·1795	1·4267	33	1·0852	1·3758			

TABLE NO. 78

Specific Gravities, Boiling Points, and Vapour Tensions of Aqueous Solutions of Glycerin (Gerlach)

Glycerol.	Parts of Glycerol compared with 100 parts of Water.	Specific Gravity.		Boiling Point. At 760 mm. Pressure.	Vapour Tension at 100° C.
		At 15° C. Water 15° C. = 1.	At 20° C. Water 20° C. = 1.		
Per cent.				°C.	mm.
100	Glycerin	1·2653	1·2620	290	64
99	9900	1·2628	1·2594	239	87
98	4900	1·2602	1·2568	208	107
97	3233·333	1·2577	1·2542	188	126
96	2400	1·2552	1·2516	175	144
95	1900	1·2526	1·2490	164	162
94	1566·666	1·2501	1·2464	156	180
93	1328·571	1·2476	1·2438	150	198
92	1150	1·2451	1·2412	145	215
91	1011·111	1·2425	1·2386	141	231
90	900	1·2400	1·2360	138	247
89	809·090	1·2373	1·2333	135	263
88	733·333	1·2346	1·2306	132·5	279
87	669·231	1·2319	1·2279	130·5	295
86	614·286	1·2292	1·2252	129	311
85	566·666	1·2265	1·2225	127·5	326
84	525	1·2238	1·2198	126	340
83	488·235	1·2211	1·2171	124·5	355
82	455·555	1·2184	1·2144	123	370
81	426·316	1·2157	1·2117	122	384
80	400	1·2130	1·2090	121	396
79	376·190	1·2102	1·2063	120	408
78	354·500	1·2074	1·2036	119	419
77	334·782	1·2046	1·2009	118·2	430
76	316·666	1·2018	1·1982	117·4	440
75	300	1·1990	1·1955	116·7	450
74	284·615	1·1962	1·1928	116	460
73	270·370	1·1934	1·1901	115·4	470
72	257·143	1·1906	1·1874	114·8	480
71	244·828	1·1878	1·1847	114·2	489
70	233·333	1·1850	1·1820	113·6	496
65	185·714	1·1710	1·1685	111·3	553
60	150	1·1570	1·1550	109	565
55	122·222	1·1430	1·1415	107·5	593
50	100	1·1290	1·1280	106	618
45	81·818	1·1155	1·1145	105	639
40	66·666	1·1020	1·1010	104	657
35	53·846	1·0885	1·0875	103·4	675
30	42·857	1·0750	1·0740	102·8	690
25	33·333	1·0620	1·0610	102·3	704
20	25	1·0490	1·0480	101·8	717
10	11·111	1·0245	1·0235	100·9	740
0	0	1·0000	1·0000	100	760

PART III

GENERAL TABLES

TABLE NO. 79

Comparison of different Thermometric Scales

Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.
−40	−40·0	−32·0	+10	−12·2	−9·8	+60	+15·6	+12·4
39	39·4	31·6	11	11·7	9·3	61	16·1	12·9
38	38·9	31·1	12	11·1	8·9	62	16·7	13·3
37	38·3	30·7	13	10·6	8·4	63	17·2	13·8
36	37·8	30·2	14	10·0	8·0	64	17·8	14·2
35	37·2	29·8	15	9·4	7·6	65	18·3	14·7
34	36·7	29·3	16	8·9	7·1	66	18·9	15·1
33	36·1	28·9	17	8·3	6·7	67	19·4	15·6
32	35·6	28·4	18	7·8	6·2	68	20·0	16·0
31	35·0	28·0	19	7·2	5·8	69	20·6	16·4
30	34·4	27·6	20	6·7	5·3	70	21·1	16·9
29	33·9	27·1	21	6·1	4·9	71	21·7	17·3
28	33·3	26·7	22	5·6	4·4	72	22·2	17·8
27	32·8	26·2	23	5·0	4·0	73	22·8	18·2
26	32·2	25·8	24	4·4	3·6	74	23·3	18·7
25	31·7	25·3	25	3·9	3·1	75	23·9	19·1
24	31·1	24·9	26	3·3	2·7	76	24·4	19·6
23	30·6	24·4	27	2·8	2·2	77	25·0	20·0
22	30·0	24·0	28	2·2	1·8	78	25·6	20·4
21	29·4	23·6	29	1·7	1·3	79	26·1	20·9
20	28·9	23·1	30	1·1	0·9	80	26·7	21·3
19	28·3	22·7	31	0·6	0·4	81	27·2	21·8
18	27·8	22·2	32	+0·0	+0·0	82	27·8	22·2
17	27·2	21·8	33	0·6	0·4	83	28·3	22·7
16	26·7	21·3	34	1·1	0·9	84	28·9	23·1
15	26·1	20·9	35	1·7	1·3	85	29·4	23·6
14	25.6	20·4	36	2·2	1·8	86	30·0	24·0
13	25·0	20·0	37	2·8	2·2	87	30·6	24·4
12	24·4	19·6	38	3·3	2·7	88	31·1	24·9
11	23·9	19·1	39	3·9	3·1	89	31·7	25·3
10	23·3	18·7	40	4·4	3·6	90	32·2	25·8
9	22·8	18·2	41	5·0	4·0	91	32·8	26·2
8	22·2	17·8	42	5·6	4·4	92	33·3	26·7
7	21·7	17·3	43	6·1	4·9	93	33·9	27·1
6	21·1	16·9	44	6·7	5·3	94	34·4	27·6
5	20·6	16·4	45	7·2	5·8	95	35·0	28·0
4	20·0	16·0	46	7·8	6·2	96	35·6	28·4
3	19·4	15·6	47	8·3	6·7	97	36·1	28·9
2	18·9	15·1	48	8·9	7·1	98	36·7	29·3
1	18·3	14·7	49	9·4	7·6	99	37·2	29·8
0	17·8	14·2	50	10·0	8·0	100	37·8	30·2
+1	17·2	13·8	51	10·6	8·4	101	38·3	30·7
2	16·7	13·3	52	11·1	8·9	102	38·9	31·1
3	16·1	12·9	53	11·7	9·3	103	39·4	31·6
4	15·6	12·4	54	12·2	9·8	104	40·0	32·0
5	15·0	12·0	55	12·8	10·2	105	40·6	32·4
6	14·4	11·6	56	13·3	10·7	106	41·1	32·9
7	13·9	11·1	57	13·9	11·1	107	41·7	33·3
8	13·3	10·7	58	14·4	11·6	108	42·2	33·8
9	12·8	10·2	59	15·0	12·0	109	42·8	34·2

TABLE No. 79—*continued*

Comparison of different Thermometric Scales

Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.
+110	+43·3	+34·7	+145	+62·8	+50·2	+180	+82·2	+65·8
111	43·9	35·1	146	63·3	50·7	181	82·8	66·2
112	44·4	35·6	147	63·9	51·1	182	83·3	66·7
113	45·0	36·0	148	64·4	51·6	183	83·9	67·1
114	45·6	36·4	149	65·0	52·0	184	84·4	67·6
115	46·1	36·9	150	65·6	52·4	185	85·0	68·0
116	46·7	37·3	151	66·1	52·9	186	85·6	68·4
117	47·2	37·8	152	66·7	53·3	187	86·1	68·9
118	47·8	38·2	153	67·2	53·8	188	86·7	69·3
119	48·3	38·7	154	67·8	54·2	189	87·2	69·8
120	48·9	39·1	155	68·3	54·7	190	87·8	70·2
121	49·4	39·6	156	68·9	55·1	191	88·3	70·7
122	50·0	40·0	157	69·4	55·6	192	88·9	71·1
123	50·6	40·4	158	70·0	56·0	193	89·4	71·6
124	51·1	40·9	159	70·6	56·4	194	90·0	72·0
125	51·7	41·3	160	71·1	56·9	195	90·6	72·4
126	52·2	41·8	161	71·7	57·3	196	91·1	72·9
127	52·8	42·2	162	72·2	57·8	197	91·7	73·3
128	53·3	42·7	163	72·8	58·2	198	92·2	73·8
129	53·9	43·1	164	73·3	58·7	199	92·8	74·2
130	54·4	43·6	165	73·9	59·1	200	93·3	74·7
131	55·0	44·0	166	74·4	59·6	201	93·9	75·1
132	55·6	44·4	167	75·0	60·0	202	94·4	75·6
133	56·1	44·9	168	75·6	60·4	203	95·0	76·0
134	56·7	45·3	169	76·1	60·9	204	95·6	76·4
135	57·2	45·8	170	76·7	61·3	205	96·1	76·9
136	57·8	46·2	171	77·2	61·8	206	96·7	77·3
137	58·3	46·7	172	77·8	62·2	207	97·2	77·8
138	58·9	47·1	173	78·3	62·7	208	97·8	78·2
139	59·4	47·6	174	78·9	63·1	209	98·3	78·7
140	60·0	48·0	175	79·4	63·6	210	98·9	79·1
141	60·6	48·4	176	80·0	64·0	211	99·4	79·6
142	61·1	48·9	177	80·6	64·4	212	100·0	80·0
143	61·7	49·3	178	81·1	64·9			
144	62·2	49·8	179	81·7	65·3			

TABLE No. 80

Comparison of different Thermometric Scales

Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.	Cels.	Réaum.	Fahr.
−40	−32·0	−40·0	+7	+5·6	+44·6	+54	+43·2	+129·2
39	31·2	38·2	8	6·4	46·4	55	44·0	131·0
38	30·4	36·4	9	7·2	48·2	56	44·8	132·8
37	29·6	34·6	10	8·0	50·0	57	45·6	134·6
36	28·8	32·8	11	8·8	51·8	58	46·4	136·4
35	28·0	31·0	12	9·6	53·6	59	47·2	138·2
34	27·2	29·2	13	10·4	55·4	60	48·0	140·0
33	26·4	27·4	14	11·2	57·2	61	48·8	141·8
32	25·6	25·6	15	12·0	59·0	62	49·6	143·6
31	24·8	23·8	16	12·8	60·8	63	50·4	145·4
30	24·0	22·0	17	13·6	62·6	64	51·2	147·2
29	23·2	20·2	18	14·4	64·4	65	52·0	149·0
28	22·4	18·4	19	15·2	66·2	66	52·8	150·8
27	21·6	16·6	20	16·0	68·0	67	53·6	152·6
26	20·8	14·8	21	16·8	69·8	68	54·4	154·4
25	20·0	13·0	22	17·6	71·6	69	55·2	156·2
24	19·2	11·2	23	18·4	73·4	70	56·0	158·0
23	18·4	9·4	24	19·2	75·2	71	56·8	159·8
22	17·6	7·6	25	20·0	77·0	72	57·6	161·6
21	16·8	5·8	26	20·8	78·8	73	58·4	163·4
20	16·0	4·0	27	21·6	80·6	74	59·2	165·2
19	15·2	2·2	28	22·4	82·4	75	60·0	167·0
18	14·4	0·4	29	23·2	84·2	76	60·8	168·8
17	13·6	+1·4	30	24·0	86·0	77	61·6	170·6
16	12·8	3·2	31	24·8	87·8	78	62·4	172·4
15	12·0	5·0	32	25·6	89·6	79	63·2	174·2
14	11·2	6·8	33	26·4	91·4	80	64·0	176·0
13	10·4	8·6	34	27·2	93·2	81	64·8	177·8
12	9·6	10·4	35	28·0	95·0	82	65·6	179·6
11	8·8	12·2	36	28·8	96·8	83	66·4	181·4
10	8·0	14·0	37	29·6	98·6	84	67·2	183·2
9	7·2	15·8	38	30·4	100·4	85	68·0	185·0
8	6·4	17·6	39	31·2	102·2	86	68·8	186·8
7	5·6	19·4	40	32·0	104·0	87	69·6	188·6
6	4·8	21·2	41	32·8	105·8	88	70·4	190·4
5	4·0	23·0	42	33·6	107·6	89	71·2	192·2
4	3·2	24·8	43	34·4	109·4	90	72·0	194·0
3	2·4	26·6	44	35·2	111·2	91	72·8	195·8
2	1·6	28·4	45	36·0	113·0	92	73·6	197·6
1	0·8	30·2	46	36·8	114·8	93	74·4	199·4
0	0·0	32·0	47	37·6	116·6	94	75·2	201·2
+1	+0·8	33·8	48	38·4	118·4	95	76·0	203·0
2	1·6	35·6	49	39·2	120·2	96	76·8	204·8
3	2·4	37·4	50	40·0	122·0	97	77·6	206·6
4	3·2	39·2	51	40·8	123·8	98	78·4	208·4
5	4·0	41·0	52	41·6	125·6	99	79·2	210·2
6	4·8	42·8	53	42·4	127·4	100	80·0	212·0

TABLE No. 81

Comparison of the Hydrometer Degrees according to Baumé and Twaddell with the Specific Gravities

Baumé.	Twaddell.	Specific Gravity.	Baumé.	Twaddell.	Specific Gravity.	Baumé.	Twaddell.	Specific Gravity.
0	0	1·000	19·3	31	1·155	36·0	66·4	1·332
0·7	1	1·005	19·8	32	1·160	36·2	67	1·335
1·0	1·4	1·007	20·0	32·4	1·162	36·6	68	1·340
1·4	2	1·010	20·3	33	1·165	37·0	69	1·345
2·0	2·8	1·014	20·9	34	1·170	37·4	70	1·350
2·1	3	1·015	21·0	34·2	1·171	37·8	71	1·355
2·7	4	1·020	21·4	35	1·175	38·0	71·4	1·357
3·0	4·4	1·022	22·0	36	1·180	38·2	72	1·360
3·4	5	1·025	22·5	37	1·185	38·6	73	1·365
4·0	5·8	1·029	23·0	38	1·190	39·0	74	1·370
4·1	6	1·030	23·5	39	1·195	39·4	75	1·375
4·7	7	1·035	24·0	40	1·200	39·8	76	1·380
5·0	7·4	1·037	24·5	41	1·205	40·0	76·6	1·383
5·4	8	1·040	25·0	42	1·210	40·1	77	1·385
6·0	9	1·045	25·5	43	1·215	40·5	78	1·390
6·7	10	1·050	26·0	44	1·220	40·8	79	1·395
7·0	10·2	1·052	26·4	45	1·225	41·0	79·4	1·397
7·4	11	1·055	26·9	46	1·230	41·2	80	1·400
8·0	12	1·060	27·0	46·2	1·231	41·6	81	1·405
8·7	13	1·065	27·4	47	1·235	42·0	82	1·410
9·0	13·4	1·067	27·9	48	1·240	42·3	83	1·415
9·4	14	1·070	28·0	48·2	1·241	42·7	84	1·420
10·0	15	1·075	28·4	49	1·245	43·0	84·8	1·424
10·6	16	1·080	28·8	50	1·250	43·1	85	1·425
11·0	16·6	1·083	29·0	50·4	1·252	43·4	86	1·430
11·2	17	1·085	29·3	51	1·255	43·8	87	1·435
11·9	18	1·090	29·7	52	1·260	44·0	87·6	1·438
12·0	18·2	1·091	30·0	52·6	1·263	44·1	88	1·440
12·4	19	1·095	30·2	53	1·265	44·4	89	1·445
13·0	20	1·100	30·6	54	1·270	44·8	90	1·450
13·6	21	1·105	31·0	54·8	1·274	45·0	90·6	1·453
14·0	21·6	1·108	31·1	55	1·275	45·1	91	1·455
14·2	22	1·110	31·5	56	1·280	45·4	92	1·460
14·9	23	1·115	32·0	57	1·285	45·8	93	1·465
15·0	23·2	1·116	32·4	58	1·290	46·0	93·6	1·468
15·4	24	1·120	32·8	59	1·295	46·1	94	1·470
16·0	25	1·125	33·0	59·4	1·297	46·4	95	1·475
16·5	26	1·130	33·3	60	1·300	46·8	96	1·480
17·0	26·8	1·134	33·7	61	1·305	47·0	96·6	1·483
17·1	27	1·135	34·0	61·6	1·308	47·1	97	1·485
17·7	28	1·140	34·2	62	1·310	47·4	98	1·490
18·0	28·4	1·142	34·6	63	1·315	47·8	99	1·495
18·3	29	1·145	35·0	64	1·320	48·0	99·6	1·498
18·8	30	1·150	35·4	65	1·325	48·1	100	1·500
19·0	30·4	1·152	35·8	66	1·330	48·4	101	1·505

TABLE No. 81—*continued*

Baumé.	Twaddell.	Specific Gravity.	Baumé.	Twaddell.	Specific Gravity.	Baumé.	Twaddell.	Specific Gravity.
48·7	102	1·510	56·0	127	1·635	61·8	150	1·750
49·0	103	1·515	56·3	128	1·640	62·0	150·6	1·753
49·4	104	1·520				62·1	151	1·755
49·7	105	1·525	56·6	129	1·645	62·3	152	1·760
50·0	106	1·530	56·9	130	1·650	62·5	153	1·765
			57·0	130·4	1·652			
50·3	107	1·535	57·1	131	1·655	62·8	154	1·770
50·6	108	1·540	57·4	132	1·660	63·0	155	1·775
50·9	109	1·545				63·2	156	1·780
51·0	109·2	1·546	57·7	133	1·665	63·5	157	1·785
51·2	110	1·550	57·9	134	1·670	63·7	158	1·790
			58·0	134·2	1·671			
51·5	111	1·555	58·2	135	1·675	64·0	159	1·795
51·8	112	1·560	58·4	136	1·680	64·2	160	1·800
52·0	112·6	1·563				64·4	161	1·805
52·1	113	1·565	58·7	137	1·685	64·6	162	1·810
52·4	114	1·570	58·9	138	1·690	64·8	163	1·815
			59·0	138·2	1·691			
52·7	115	1·575	59·2	139	1·695	65·0	164	1·820
53·0	116	1·580	59·5	140	1·700	65·2	165	1·825
53·3	117	1·585				65·5	166	1·830
53·6	118	1·590	59·7	141	1·705	65·7	167	1·835
53·9	119	1·595	60·0	142	1·710	65·9	168	1·840
			60·2	143	1·715			
54·0	119·4	1·597	60·4	144	1·720	66·0	168·4	1·842
54·1	120	1·600	60·6	145	1·725	66·1	169	1·845
54·4	121	1·605				66·3	170	1·850
54·7	122	1·610	60·9	146	1·730	66·5	171	1·855
55·0	123	1·615	61·0	146·4	1·732	66·7	172	1·860
			61·1	147	1·735			
55·2	124	1·620	61·4	148	1·740	67·0	173	1·865
55·5	125	1·625	61·6	149	1·745			
55·8	126	1·630						

TABLE No. 82

Degrees Baumé for Liquids lighter than Water at 15·5° C. = 60° F.

Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.	Degrees.	Specific Gravity.
10	1·0000	24	0·9090	38	0·8293	51	0·7734	64	0·7216
11	0·9929	25	0·9032	39	0·8284	52	0·7692	65	0·7179
12	0·9859	26	0·8974	40	0·8235	53	0·7650	66	0·7142
13	0·9790	27	0·8917	41	0·8187	54	0·7608	67	0·7106
14	0·9722	28	0·8860	42	0·8139	55	0·7567	68	0·7070
15	0·9655	29	0·8805	43	0·8092	56	0·7526	69	0·7035
16	0·9589	30	0·8750	44	0·8045	57	0·7486	70	0·7000
17	0·9523	31	0·8695	45	0·8000	58	0·7446	75	0·6829
18	0·9459	32	0·8641	46	0·7954	59	0·7407	80	0·6666
19	0·9395	33	0·8588	47	0·7909	60	0·7368	85	0·6511
20	0·9333	34	0·8536	48	0·7865	61	0·7326	90	0·6363
21	0·9271	35	0·8484	49	0·7821	62	0·7290	95	0·6222
22	0·9210	36	0·8433	50	0·7777	63	0·7253	100	0·6087
23	0·9150	37	0·8383						

TABLE NO. 83

Specific Gravities of Hydrochloric Acids

Spec. Grav. at 14° C. (in vacuo).	Degrees Baumé.	Degrees Twad.	100 Parts correspond to						1 Liter contains Kilograms					
			HCl Per Cent.	18° Bé. Acid Per Cent.	19° Bé. Acid Per Cent.	20° Bé. Acid Per Cent.	21° Bé. Acid Per Cent.	22° Bé. Acid Per Cent.	HCl.	18° Bé. Acid.	19° Bé. Acid.	20° Bé. Acid.	21° Bé. Acid.	22° Bé. Acid.
1·000	0·0	0·0	0·16	0·57	0·53	0·49	0·47	0·45	0·0016	0·0057	0·0053	0·0049	0·0047	0·0045
1·005	0·7	1	1·15	4·08	3·84	3·58	3·42	3·25	0·012	0·041	0·039	0·036	0·034	0·033
1·010	1·4	2	2·14	7·60	7·14	6·66	6·36	6·04	0·022	0·077	0·072	0·076	0·064	0·061
1·015	2·1	3	3·12	11·08	10·41	9·71	9·27	8·81	0·032	0·113	0·106	0·099	0·094	0·089
1·020	2·7	4	4·13	14·67	13·79	12·86	12·27	11·67	0·042	0·150	0·141	0·131	0·125	0·119
1·025	3·4	5	5·15	18·30	17·19	16·04	15·30	14·55	0·053	0·188	0·176	0·164	0·157	0·149
1·030	4·1	6	6·15	21·85	20·53	19·16	18·27	17·38	0·064	0·225	0·212	0·197	0·188	0·179
1·035	4·7	7	7·15	25·40	23·87	22·27	21·25	20·20	0·074	0·263	0·247	0·231	0·220	0·209
1·040	5·4	8	8·16	28·99	27·24	25·42	24·25	23·06	0·085	0·302	0·283	0·264	0·252	0·240
1·045	6·0	9	9·16	32·55	30·58	28·53	27·22	25·88	0·096	0·340	0·320	0·298	0·284	0·270
1·050	6·7	10	10·17	36·14	33·95	31·68	30·22	28·74	0·107	0·380	0·357	0·333	0·317	0·302
1·055	7·4	11	11·18	39·73	37·33	34·82	33·22	31·59	0·118	0·419	0·394	0·367	0·351	0·333
1·060	8·0	12	12·19	43·32	40·70	37·97	36·23	34·44	0·129	0·459	0·431	0·403	0·384	0·365
1·065	8·7	13	13·19	46·87	44·04	41·09	39·20	37·27	0·141	0·499	0·469	0·438	0·418	0·397
1·070	9·4	14	14·17	50·35	47·31	44·14	42·11	40·04	0·152	0·539	0·506	0·472	0·451	0·428
1·075	10·0	15	15·16	53·87	50·62	47·22	45·05	42·84	0·163	0·579	0·544	0·508	0·484	0·460
1·080	10·6	16	16·15	57·39	53·92	50·31	47·99	45·63	0·174	0·620	0·582	0·543	0·518	0·493
1·085	11·2	17	17·13	60·87	57·19	53·36	50·90	48·40	0·186	0·660	0·621	0·579	0·552	0·523
1·090	11·9	18	18·11	64·35	60·47	56·41	53·82	51·17	0·197	0·701	0·659	0·615	0·587	0·558
1·095	12·4	19	19·06	67·73	63·64	59·37	56·64	53·86	0·209	0·742	0·697	0·650	0·620	0·590
1·100	13·0	20	20·01	71·11	66·81	62·33	59·46	56·54	0·220	0·782	0·735	0·686	0·654	0·622
1·105	13·6	21	20·97	74·52	70·01	65·32	62·32	59·26	0·232	0·823	0·774	0·722	0·689	0·655
1·110	14·2	22	21·92	77·89	73·19	68·28	65·14	61·94	0·243	0·865	0·812	0·758	0·723	0·687
1·115	14·9	23	22·86	81·23	76·32	71·21	67·93	64·60	0·255	0·906	0·851	0·794	0·757	0·719
1·120	15·4	24	23·82	84·64	79·53	74·20	70·79	67·31	0·267	0·948	0·891	0·831	0·793	0·754
1·125	16·0	25	24·78	88·06	82·74	77·19	73·74	70·02	0·278	0·991	0·931	0·868	0·828	0·788
1·130	16·5	26	25·75	91·50	85·97	80·21	76·52	72·76	0·291	1·034	0·972	0·906	0·865	0·822
1·135	17·1	27	26·70	94·88	89·15	83·18	79·34	75·45	0·303	1·077	1·011	0·944	0·901	0·856
1·140	17·7	28	27·66	98·29	92·35	86·17	82·20	78·16	0·315	1·121	1·053	0·982	0·937	0·891
1·1425	18·0	...	28·14	100·00	93·95	87·66	83·62	79·51	0·322	1·143	1·073	1·002	0·955	0·908
1·145	18·3	29	28·61	101·67	95·52	89·13	85·02	80·84	0·328	1·164	1·094	1·021	0·973	0·926
1·150	18·8	30	29·57	105·08	98·73	92·11	87·87	83·55	0·340	1·208	1·135	1·059	0·011	0·961
1·152	19·0	...	29·95	106·43	100·00	93·30	89·01	84·63	0·345	1·226	1·152	1·075	1·025	0·975
1·155	19·3	31	30·55	108·58	102·00	95·17	90·79	86·32	0·353	1·254	1·178	1·099	1·049	0·997
1·160	19·8	32	31·52	112·01	105·24	98·19	93·67	89·07	0·366	1·299	1·221	1·139	1·087	1·033
1·163	20·0	...	32·10	114·07	107·17	100·00	95·39	90·70	0·373	1·326	1·246	1·163	1·109	1·054
1·165	20·3	33	32·49	115·46	108·48	101·21	96·55	91·81	0·379	1·345	1·264	1·179	1·125	1·070
1·170	20·9	34	33·46	118·91	111·71	104·24	99·43	94·55	0·392	1·391	1·307	1·220	1·163	1·106
1·171	21·0	...	33·65	119·58	112·35	104·82	100·00	95·09	0·394	1·400	1·316	1·227	1·171	1·113
1·175	21·4	35	34·42	122·32	114·92	107·22	102·28	97·26	0·404	1·437	1·350	1·260	1·202	1·143
1·180	22·0	36	35·39	125·76	118·16	110·24	105·17	100·00	0·418	1·484	1·394	1·301	1·241	1·180
1·185	22·5	37	36·31	129·03	121·23	113·11	107·90	102·60	0·430	1·529	1·437	1·340	1·279	1·216
1·190	23·0	38	37·23	132·30	124·30	115·98	110·63	105·20	0·443	1·574	1·479	1·380	1·317	1·252
1·195	23·5	39	38·16	135·61	127·41	118·87	113·40	107·83	0·456	1·621	1·523	1·421	1·355	1·289
1·200	24·0	40	39·11	138·98	130·58	121·84	116·22	110·51	0·469	1·667	1·567	1·462	1·395	1·326

TABLE NO. 84

Specific Gravities of Mixtures of Pure Sulphuric Acid and Water

Specific Gravity at 15° C. (in vacuo)	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO_3. Per cent.	SO_4H_2. Per cent.	60 Degrees Acid. Per cent.	50 Degrees Acid. Per cent.	SO_3.	SO_4H_2.	60 Degrees Acid.	50 Degrees Acid.
1·000	0	0	0·07	0·09	0·12	0·14	0·001	0·001	0·001	0·001
1·005	0·7	1	0·68	0·83	1·06	1·33	0·007	0·008	0·011	0·013
1·010	1·4	2	1·28	1·57	2·01	2·51	0·013	0·016	0·020	0·025
1·015	2·1	3	1·88	2·30	2·95	3·68	0·019	0·023	0·030	0·037
1·020	2·7	4	2·47	3·03	3·88	4·85	0·025	0·031	0·040	0·050
1·025	3·4	5	3·07	3·76	4·82	6·02	0·032	0·039	0·049	0·062
1·030	4·1	6	3·67	4·49	5·78	7·18	0·038	0·046	0·059	0·074
1·035	4·7	7	4·27	5·23	6·73	8·37	0·044	0·054	0·070	0·087
1·040	5·4	8	4·87	5·96	7·64	9·54	0·051	0·062	0·079	0·099
1·045	6·0	9	5·45	6·67	8·55	10·67	0·057	0·071	0·089	0·112
1·050	6·7	10	6·02	7·37	9·44	11·79	0·063	0·077	0·099	0·124
1·055	7·4	11	6·59	8·07	10·34	12·91	0·070	0·085	0·109	0·136
1·060	8·0	12	7·16	8·77	11·24	14·03	0·076	0·093	0·119	0·149
1·065	8·7	13	7·73	9·47	12·14	15·15	0·082	0·102	0·129	0·161
1·070	9·4	14	8·32	10·19	13·05	16·30	0·089	0·109	0·140	0·174
1·075	10·0	15	8·90	10·90	13·96	17·44	0·096	0·117	0·150	0·188
1·080	10·6	16	9·47	11·60	14·87	18·56	0·103	0·125	0·161	0·201
1·085	11·2	17	10·04	12·30	15·76	19·68	0·109	0·133	0·171	0·213
1·090	11·9	18	10·60	12·99	16·65	20·78	0·116	0·142	0·181	0·227
1·095	12·4	19	11·16	13·67	17·52	21·87	0·122	0·150	0·192	0·240
1·100	13·0	20	11·71	14·35	18·39	22·96	0·129	0·158	0·202	0·253
1·105	13·6	21	12·27	15·03	19·26	24·05	0·136	0·166	0·212	0·265
1·110	14·2	22	12·82	15·71	20·13	25·14	0·143	0·175	0·223	0·279
1·115	14·9	23	13·36	16·36	20·96	26·18	0·149	0·183	0·234	0·292
1·120	15·4	24	13·89	17·01	21·80	27·22	0·156	0·191	0·245	0·305
1·125	16·0	25	14·42	17·66	22·63	28·26	0·162	0·199	0·255	0·318
1·130	16·5	26	14·95	18·31	23·47	29·30	0·169	0·207	0·265	0·331
1·135	17·1	27	15·48	18·96	24·29	30·34	0·176	0·215	0·276	0·344
1·140	17·7	28	16·01	19·61	25·13	31·38	0·183	0·223	0·287	0·358
1·145	18·3	29	16·54	20·26	25·96	32·42	0·189	0·231	0·297	0·371
1·150	18·8	30	17·07	20·91	26·79	33·46	0·196	0·239	0·308	0·385
1·155	19·3	31	17·59	21·55	27·61	34·48	0·203	0·248	0·319	0·398
1·160	19·8	32	18·11	22·19	28·43	35·50	0·210	0·257	0·330	0·412
1·165	20·3	33	18·64	22·83	29·25	36·53	0·217	0·266	0·341	0·426
1·170	20·9	34	19·16	23·47	30·07	37·55	0·224	0·275	0·352	0·439
1·175	21·4	35	19·69	24·12	30·90	38·59	0·231	0·283	0·363	0·453
1·180	22·0	36	20·21	24·76	31·73	39·62	0·238	0·292	0·374	0·467
1·185	22·5	37	20·73	25·40	32·55	40·64	0·246	0·301	0·386	0·481
1·190	23·0	38	21·26	26·04	33·37	41·66	0·253	0·310	0·397	0·496
1·195	23·5	39	21·78	26·68	34·19	42·69	0·260	0·319	0·409	0·511
1·200	24·0	40	22·30	27·32	35·01	43·71	0·268	0·328	0·420	0·525
1·205	24·5	41	22·82	27·95	35·83	44·72	0·275	0·337	0·432	0·539
1·210	25·0	42	23·33	28·58	36·66	45·73	0·282	0·346	0·444	0·553
1·215	25·5	43	23·84	29·21	37·45	46·74	0·290	0·355	0·455	0·568
1·220	26·0	44	24·36	29·84	38·23	47·74	0·297	0·364	0·466	0·583

TABLE NO. 84—*continued*

Specific Gravity at 15° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO_3. Per cent.	SO_4H_2. Per cent.	60 Degrees Acid. Per cent.	50 Degrees Acid. Per cent.	SO_3.	SO_4H_2.	60 Degrees Acid.	50 Degrees Acid.
1·225	26·4	45	24·88	30·48	39·05	48·77	0·305	0·373	0·478	0·598
1·230	26·9	46	25·39	31·11	39·86	49·78	0·312	0·282	0·490	0·612
1·235	27·4	47	25·88	31·70	40·61	50·72	0·320	0·391	0·502	0·626
1·240	27·9	48	26·35	32·28	41·37	51·65	0·327	0·400	0·513	0·640
1·245	28·4	49	26·83	32·86	42·11	52·58	0·334	0·409	0·524	0·655
1·250	28·8	50	27·29	33·43	42·84	53·49	0·341	0·418	0·535	0·669
1·255	29·3	51	27·76	34·00	43·57	54·40	0·348	0·426	0·547	0·683
1·260	29·7	52	28·22	34·57	44·30	55·31	0·356	0·435	0·558	0·697
1·265	30·2	53	28·69	35·14	45·03	56·22	0·363	0·444	0·570	0·711
1·270	30·6	54	29·15	35·71	45·76	57·14	0·370	0·454	0·581	0·725
1·275	31·1	55	29·62	36·29	46·50	58·06	0·377	0·462	0·593	0·740
1·280	31·5	56	30·10	36·87	47·24	58·99	0·385	0·472	0·605	0·755
1·285	32·0	57	30·57	37·45	47·99	59·92	0·393	0·481	0·617	0·770
1·290	32·4	58	31·04	38·03	48·73	60·85	0·400	0·490	0·629	0·785
1·295	32·8	59	31·52	38·61	49·47	61·78	0·408	0·500	0·641	0·800
1·300	33·3	60	31·99	39·19	50·21	62·70	0·416	0·510	0·653	0·815
1·305	33·7	61	32·46	39·77	50·96	63·63	0·424	0·519	0·665	0·830
1·310	34·2	62	32·94	40·35	51·71	64·56	0·432	0·529	0·677	0·845
1·315	34·6	63	33·41	40·93	52·45	65·45	0·439	0·538	0·689	0·860
1·320	35·0	64	33·88	41·50	53·18	66·40	0·447	0·548	0·702	0·876
1·325	35·4	65	34·35	42·08	53·92	67·33	0·455	0·557	0·714	0·892
1·330	35·8	66	34·80	42·66	54·67	68·26	0·462	0·567	0·727	0·908
1·335	36·2	67	35·27	43·20	55·36	69·12	0·471	0·577	0·739	0·923
1·340	36·6	68	35·71	43·74	56·05	69·98	0·479	0·586	0·751	0·938
1·345	37·0	69	36·14	44·28	56·74	70·85	0·486	0·596	0·763	0·953
1·350	37·4	70	36·58	44·82	57·43	71·71	0·494	0·605	0·775	0·968
1·355	37·8	71	37·02	45·35	58·11	72·56	0·502	0·614	0·787	0·983
1·360	38·2	72	37·45	45·88	58·79	73·41	0·509	0·624	0·800	0·998
1·365	38·6	73	37·89	46·41	59·48	74·26	0·517	0·633	0·812	1·014
1·370	39·0	74	38·32	46·94	60·15	75·10	0·525	0·643	0·824	1·029
1·375	39·4	75	38·75	47·47	60·83	75·95	0·533	0·653	0·836	1·044
1·380	39·8	76	39·18	48·00	61·51	76·80	0·541	0·662	0·849	1·060
1·385	40·1	77	39·62	48·53	62·19	77·65	0·549	0·672	0·861	1·075
1·390	40·5	78	40·05	49·06	62·87	78·50	0·557	0·682	0·873	1·091
1·395	40·8	79	40·48	49·59	63·55	79·34	0·564	0·692	0·886	1·107
1·400	41·2	80	40·91	50·11	64·21	80·18	0·573	0·702	0·899	1·123
1·405	41·6	81	41·33	50·63	64·88	81·01	0·581	0·711	0·912	1·138
1·410	42·0	82	41·76	51·15	65·55	81·86	0·589	0·721	0·924	1·154
1·415	42·3	83	42·17	51·66	66·21	82·66	0·597	0·730	0·937	1·170
1·420	42·7	84	42·57	52·15	66·82	83·44	0·604	0·740	0·949	1·185
1·425	43·1	85	42·96	52·63	67·44	84·21	0·612	0·750	0·961	1·200
1·430	43·4	86	43·36	53·11	68·06	84·98	0·620	0·759	0·973	1·215
1·435	43·8	87	43·75	53·59	68·68	85·74	0·628	0·769	0·986	1·230
1·440	44·1	88	44·14	54·07	69·29	86·51	0·636	0·779	0·998	1·246
1·445	44·4	89	44·53	54·55	69·90	87·28	0·643	0·789	1·010	1·261
1·450	44·8	90	44·92	55·03	70·52	88·05	0·651	0·798	1·023	1·277
1·455	45·1	91	45·31	55·50	71·12	88·80	0·659	0·808	1·035	1·292
1·460	45·4	92	45·69	55·97	71·72	89·55	0·667	0·817	1·047	1·307
1·465	45·8	93	46·07	56·43	72·31	90·29	0·675	0·827	1·059	1·323
1·470	46·1	94	46·45	56·90	72·91	91·04	0·683	0·837	1·072	1·338
1·475	46·4	95	46·83	57·37	73·51	91·79	0·691	0·846	1·084	1·354
1·480	46·8	96	47·21	57·83	74·10	92·53	0·699	0·856	1·097	1·370

TABLE No. 84—*continued*

Specific Gravity at 15° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO_3. Per cent.	SO_4H_2. Per cent.	60 Degrees Acid Per cent.	50 Degrees Acid Per cent.	SO_3.	SO_4H_2.	60 Degrees Acid.	50 Degrees Acid.
1·485	47·1	97	47·57	58·28	74·68	93·25	0·707	0·865	1·109	1·385
1·490	47·4	98	47·95	58·74	75·27	93·98	0·715	0·876	1·122	1·400
1·495	47·8	99	48·34	59·22	75·88	94·75	0·723	0·885	1·134	1·417
1·500	48·1	100	48·73	59·70	76·50	95·52	0·731	0·896	1·147	1·433
1·505	48·4	101	49·12	60·18	77·12	96·29	0·739	0·906	1·160	1·449
1·510	48·7	102	49·51	60·65	77·72	97·04	0·748	0·916	1·174	1·465
1·515	49·0	103	49·89	61·12	78·32	97·79	0·756	0·926	1·187	1·481
1·520	49·4	104	50·28	61·59	78·93	98·54	0·764	0·936	1·199	1·498
1·525	49·7	105	50·66	62·06	79·52	99·30	0·773	0·946	1·213	1·514
1·530	50·0	106	51·04	62·53	80·13	100·05	0·781	0·957	1·226	1·531
1·535	50·3	107	51·43	63·00	80·73	100·80	0·789	0·967	1·239	1·547
1·540	50·6	108	51·78	63·43	81·28	101·49	0·797	0·977	1·252	1·563
1·545	50·9	109	52·12	63·85	81·81	102·16	0·805	0·987	1·264	1·579
1·550	51·2	110	52·46	64·26	82·34	102·82	0·813	0·996	1·276	1·593
1·555	51·5	111	52·79	64·67	82·87	103·47	0·821	1·006	1·289	1·609
1·560	51·8	112	53·12	65·08	83·39	104·13	0·829	1·015	1·301	1·624
1·565	52·1	113	53·46	65·49	83·92	104·78	0·837	1·025	1·313	1·640
1·570	52·4	114	53·80	65·90	84·44	105·44	0·845	1·035	1·325	1·655
1·575	52·7	115	54·13	66·30	84·95	106·08	0·853	1·044	1·338	1·671
1·580	53·0	116	54·46	66·71	85·48	106·73	0·861	1·054	1·351	1·686
1·585	53·3	117	54·80	67·13	86·03	107·41	0·869	1·064	1·364	1·702
1·590	53·6	118	55·18	67·59	86·62	108·14	0·877	1·075	1·377	1·719
1·595	53·9	119	55·55	68·05	87·20	108·88	0·886	1·085	1·391	1·737
1·600	54·1	120	55·93	68·51	87·79	109·62	0·895	1·096	1·405	1·754
1·605	54·4	121	56·30	68·97	88·38	110·35	0·904	1·107	1·419	1·772
1·610	54·7	122	56·68	69·43	88·97	111·09	0·913	1·118	1·432	1·789
1·615	55·0	123	57·05	69·89	89·56	111·82	0·921	1·128	1·446	1·806
1·620	55·2	124	57·40	70·32	90·11	112·51	0·930	1·139	1·460	1·823
1·625	55·5	125	57·75	70·74	90·65	113·18	0·938	1·150	1·473	1·840
1·630	55·8	126	58·09	71·16	91·19	113·86	0·947	1·160	1·486	1·857
1·635	56·0	127	58·43	71·57	91·71	114·51	0·955	1·170	1·499	1·873
1·640	56·3	128	58·77	71·99	92·25	115·18	0·964	1·181	1·513	1·889
1·645	56·6	129	59·10	72·40	92·77	115·84	0·972	1·192	1·526	1·905
1·650	56·9	130	59·45	72·82	93·29	116·51	0·981	1·202	1·540	1·922
1·655	57·1	131	59·78	73·23	93·81	117·17	0·989	1·212	1·553	1·939
1·660	57·4	132	60·11	73·64	94·36	117·82	0·998	1·222	1·566	1·956
1·665	57·7	133	60·46	74·07	94·92	118·51	1·007	1·233	1·580	1·973
1·670	57·9	134	60·82	74·51	95·48	119·22	1·016	1·244	1·595	1·991
1·675	58·2	135	61·20	74·97	96·07	119·95	1·025	1·256	1·609	2·009
1·680	58·4	136	61·57	75·42	96·65	120·67	1·034	1·267	1·623	2·027
1·685	58·7	137	61·93	75·86	97·21	121·38	1·043	1·278	1·638	2·046
1·690	58·9	138	62·29	76·30	97·77	122·08	1·053	1·289	1·652	2·064
1·695	59·2	139	62·64	76·73	98·32	122·77	1·062	1·301	1·667	2·082
1·700	59·5	140	63·00	77·17	98·89	123·47	1·071	1·312	1·681	2·100
1·705	59·7	141	63·35	77·60	99·44	124·16	1·080	1·323	1·696	2·117
1·710	60·0	142	63·70	78·04	100·00	124·86	1·089	1·334	1·710	2·136
1·715	60·2	143	64·07	78·48	100·56	125·57	1·099	1·346	1·725	2·154
1·720	60·4	144	64·43	78·92	101·13	126·27	1·108	1·357	1·739	2·172
1·725	60·6	145	64·78	79·36	101·69	126·98	1·118	1·369	1·754	2·191
1·730	60·9	146	65·14	79·80	102·25	127·68	1·127	1·381	1·769	2·209
1·735	61·1	147	65·50	80·24	102·82	128·38	1·136	1·392	1·784	2·228
1·740	61·4	148	65·86	80·68	103·38	129·09	1·146	1·404	1·799	2·247

TABLE No. 84—*continued*

Specific Gravity at 4° C. (in vacuo).	Degrees Baumé.	Degrees Twaddell.	100 Parts contain				1 Liter contains Kilograms			
			SO_3. Per cent.	SO_4H_2. Per cent.	60 Degrees Acid Per cent.	50 Degrees Acid Per cent.	SO_3.	SO_4H_2.	60 Degrees Acid.	50 Degrees Acid.
1·745	61·6	149	66·22	81·12	103·95	129·79	1·156	1·416	1·814	2·265
1·750	61·8	150	66·58	81·56	104·52	130·49	1·165	1·427	1·829	2·284
1·755	62·1	151	66·94	82·00	105·08	131·20	1·175	1·439	1·845	2·303
1·760	62·3	152	67·30	82·44	105·64	131·90	1·185	1·451	1·859	2·321
1·765	62·5	153	67·65	82·88	106·21	132·61	1·194	1·463	1·874	2·340
1·770	62·8	154	68·02	83·32	106·77	133·31	1·204	1·475	1·890	2·359
1·775	63·0	155	68·49	83·90	107·51	134·24	1·216	1·489	1·908	2·381
1·780	63·2	156	68·98	84·50	108·27	135·20	1·228	1·504	1·928	2·407
1·785	63·5	157	69·47	85·10	109·05	136·16	1·240	1·519	1·947	2·432
1·790	63·7	158	69·96	85·70	109·82	137·14	1·252	1·534	1·965	2·455
1·795	64·0	159	70·45	86·30	110·58	138·08	1·265	1·549	1·983	2·479
1·800	64·2	160	70·94	86·90	111·35	139·06	1·277	1·564	2·004	2·503
1·805	64·4	161	71·50	87·60	112·25	140·16	1·291	1·581	2·026	2·530
1·810	64·6	162	72·08	88·30	113·15	141·28	1·305	1·598	2·048	2·558
1·815	64·8	163	72·69	89·05	114·11	142·48	1·319	1·621	2·071	2·587
1·820	65·0	164	73·51	90·05	115·33	144·08	1·338	1·639	2·099	2·622
1·821	...	...	73·63	90·20	115·59	144·32	1·341	1·643	2·104	2·628
1·822	65·1	...	73·80	90·40	115·84	144·64	1·345	1·647	2·110	2·635
1·823	...	...	73·96	90·60	116·10	144·96	1·348	1·651	2·116	2·643
1·824	65·2	...	74·12	90·80	116·35	145·28	1·352	1·656	2·122	2·650
1·825	...	165	74·29	91·00	116·61	145·60	1·356	1·661	2·128	2·657
1·826	65·3	...	74·49	91·25	116·93	146·00	1·360	1·666	2·135	2·666
1·827	...	...	74·69	91·50	117·25	146·40	1·364	1·671	2·142	2·675
1·828	65·4	...	74·86	91·70	117·51	146·72	1·368	1·676	2·148	2·682
1·829	...	...	75·03	91·90	117·76	147·04	1·372	1·681	2·154	2·689
1·830	...	166	75·19	92·10	118·02	147·36	1·376	1·685	2·159	2·696
1·831	65·5	...	75·35	92·30	118·27	147·68	1·380	1·690	2·165	2·704
1·832	...	...	75·53	92·52	118·56	148·03	1·384	1·695	2·172	2·711
1·833	65·6	...	75·72	92·75	118·85	148·40	1·388	1·700	2·178	2·720
1·834	...	...	75·96	93·05	119·23	148·88	1·393	1·706	2·186	2·730
1·835	65·7	167	76·27	93·43	119·72	149·49	1·400	1·713	2·196	2·743
1·836	...	...	76·57	93·80	120·19	150·08	1·406	1·722	2·207	2·755
1·837	...	...	76·90	94·20	120·71	150·72	1·412	1·730	2·217	2·769
1·838	65·8	...	77·23	94·60	121·22	151·36	1·419	1·739	2·228	2·782
1·839	...	...	77·55	95·00	121·74	152·00	1·426	1·748	2·239	2·795
1·840	65·9	168	78·04	95·60	122·51	152·96	1·436	1·759	2·254	2·814
1·8405	...	...	78·33	95·95	122·96	153·52	1·451	1·765	2·262	2·825
1·8410	...	...	79·19	97·00	124·30	155·20	1·458	1·786	2·288	2·857
1·8415	...	...	79·76	97·70	125·20	156·32	1·469	1·799	2·305	2·879
1·8410	...	...	80·16	98·20	125·84	157·12	1·476	1·808	2·317	2·893
1·8405	...	...	80·57	98·70	126·48	157·92	1·483	1·816	2·328	2·906
1·8400	...	...	80·98	99·20	127·12	158·72	1·490	1·825	2·339	2·920
1·8395	...	...	81·18	99·45	127·44	159·12	1·494	1·830	2·344	2·927
1·8390	...	...	81·39	99·70	127·76	159·52	1·497	1·834	2·349	2·933
1·8385	...	...	81·59	99·95	128·08	159·92	1·500	1·838	2·355	2·940

TABLE No. 85.—*Specific Gravities of Commercial Fuming Sulphuric Acid*

At 15°	At 20°.	At 25°.	At 30°.	At 35°.	SO_3. Per cent.
1·8417	1·8371	1·8323	1·8287	1·8240	76·67
1·8427	1·8378	1·8333	1·8295	1·8249	77·49
1·8428	1·8388	1·8351	1·8302	1·8255	78·34
1·8437	1·8390	1·8346	1·8300	1·8257	79·04
1·8427	1·8386	1·8351	1·8297	1·8250	79·99
1·8420	1·8372	1·8326	1·8281	1·8234	80·46
1·8398	1·8350	1·8305	1·8263	1·8218	80·94
1·8446	1·8400	1·8353	1·8307	1·8262	81·37
1·8509	1·8466	1·8418	1·8371	1·8324	81·91
1·8571	1·8522	1·8476	1·8432	1·8385	82·17
1·8697	1·8647	1·8595	1·8545	1·8498	82·94
1·8790	1·8742	1·8687	1·8640	1·8592	83·25
1·8875	1·8823	1·8767	1·8713	1·8661	83·84
1·8942	1·8888	1·8833	1·8775	1·8722	84·12
1·8990	1·8940	1·8890	1·8830	1·8772	84·33
1·9034	1·8984	1·8930	1·8874	1·8820	84·67
1·9072	1·9021	1·8950	1·8900	1·8845	84·82
1·9095	1·9042	1·8986	1·8932	1·8866	84·99
1·9121	1·9053	1·8993	1·8948	1·8892	85·14
1·9250	1·9193	1·9135	1·9082	1·9023	85·54
1·9290	1·9236	1·9183	1·9129	1·9073	85·68
1·9368	1·9310	1·9250	1·9187	1·9122	85·88
1·9447	1·9392	1·9334	1·9279	1·9222	86·51
1·9520	1·9465	1·9402	1·9338	1·9278	86·72
1·9584	1·9528	1·9466	1·9406	1·9340	87·03
1·9632	1·9573	1·9518	1·9457	1·9398	87·46
cryst.	cryst.	1·9740	1·9666	1·9740	88·00

TABLE No. 86.—*Percentages of* SO_3 *in Commercial Fuming Sulphuric Acid*

SO_3 by Titration.	Acid contains. Per cent.		SO_3 by Titration.	Acid contains. Per cent.		SO_3 by Titration.	Acid contains. Per cent.		SO_3 by Titration.	Acid contains. Per cent.	
	SO_4H_2.	SO_3.		SO_4H_2.	SO_3.		SO_4H_2.	SO_3.		SO_4H_2.	SO_3.
81·6326	100	0	86·2244	75	25	90·8163	50	50	95·4081	25	75
81·8163	99	1	86·4081	74	26	91·0000	49	51	95·5918	24	76
82·0000	98	2	86·5918	73	27	91·1836	48	52	95·7755	23	77
82·1836	97	3	86·7755	72	28	91·3673	47	53	95·9591	22	78
82·3674	96	4	86·9591	71	29	91·5510	46	54	96·1428	21	79
82·5510	95	5	87·1428	70	30	91·7346	45	55	96·3265	20	80
82·7346	94	6	87·3265	69	31	91·9183	44	56	96·5102	19	81
82·9183	93	7	87·5102	68	32	92·1020	43	57	96·6938	18	82
83·1020	92	8	87·6938	67	33	92·2857	42	58	96·8775	17	83
83·2857	91	9	87·8775	66	34	92·4693	41	59	97·0612	16	84
83·4693	90	10	88·0612	65	35	92·6530	40	60	97·2448	15	85
83·6530	89	11	88·2448	64	36	92·8367	39	61	97·4285	14	86
83·8367	88	12	88·4285	63	37	93·0204	38	62	97·6122	13	87
84·0204	87	13	88·6122	62	38	93·2040	37	63	97·7959	12	88
84·2040	86	14	88·7959	61	39	93·3877	36	64	97·9795	11	89
84·3877	85	15	88·9795	60	40	93·5714	35	65	98·1632	10	90
84·5714	84	16	89·1632	59	41	93·7551	34	66	98·3469	9	91
84·7551	83	17	89·3469	58	42	93·9387	33	67	98·5306	8	92
84·9387	82	18	89·5306	57	43	94·1224	32	68	98·7142	7	93
85·1224	81	19	89·7142	56	44	94·3061	31	69	98·8979	6	94
85·3061	80	20	89·8979	55	45	94·4897	30	70	99·0816	5	95
85·4897	79	21	90·0816	54	46	94·6734	29	71	99·2653	4	96
85·6734	78	22	90·2653	53	47	94·8571	28	72	99·4489	3	97
85·8571	77	23	90·4489	52	48	95·0408	27	73	99·6326	2	98
86·0408	76	24	90·6326	51	49	95·2244	26	74	99·8163	1	99

TABLE No. 87.—*Specific Gravities of Solutions of Common Salt*

Specific Gravity.	NaCl. Per cent.	Specific Gravity.	NaCl. Per cent.	Specific Gravity.	NaCl. Per cent.
1·00725	1	1·07335	10	1·14315	19
1·01450	2	1·08097	11	1·15107	20
1·02174	3	1·08859	12	1·15931	21
1·02899	4	1·09622	13	1·16755	22
1·03624	5	1·10384	14	1·17580	23
1·04366	6	1·11146	15	1·18404	24
1·05108	7	1·11938	16	1·19228	25
1·05851	8	1·12730	17	1·20098	26
1·06593	9	1·13523	18	1·20433	26·395

TABLE No. 88.—*Specific Gravities of Mixtures of Alcohol and Water at* 15·5° C

Per cent Alcohol.	Specific Gravity corresponding to		Per cent Alcohol.	Specific Gravity corresponding to		Per cent Alcohol.	Specific Gravity corresponding to	
	Per cent by Volume.	Per cent by Weight.		Per cent by Volume.	Per cent by Weight.		Per cent by Volume.	Per cent by Weight.
1	0·9985	0·9981	35	0·9592	0·9490	68	0·8949	0·8772
2	·9970	·9963	36	·9579	·9472	69	·8925	·8748
3	·9956	·9944	37	·9565	·9453	70	·8900	·8724
4	·9942	·9928	38	·9550	·9433	71	·8875	·8700
5	·9928	·9912	39	·9535	·9413	72	·8850	·8676
6	·9915	·9896	40	·9519	·9394	73	·8825	·8652
7	·9902	·9880	41	·9503	·9374	74	·8799	·8629
8	·9890	·9866	42	·9487	·9353	75	·8773	·8605
9	·9878	·9852	43	·9470	·9332	76	·8747	·8581
10	·9866	·9839	44	·9452	·9311	77	·8720	·8557
11	·9854	·9826	45	·9435	·9291	78	·8693	·8533
12	·9843	·9813	46	·0417	·9269	79	·8666	·8509
13	·9832	·9800	47	·9399	·9248	80	·8639	·8484
14	·9821	·9788	48	·9381	·9227	81	·8611	·8459
15	·9811	·9775	49	·9362	·9204	82	·8583	·8435
16	·9800	·9763	50	·9343	·9183	83	·8555	·8409
17	·9790	·9751	51	·9323	·9160	84	·8526	·8385
18	·9780	·9739	52	·9303	·9138	85	·8946	·8359
19	·9770	·9727	53	·9283	·9116	86	·8466	·8333
20	·9760	·9714	54	·9263	·9094	87	·8436	·8307
21	·9750	·9702	55	·9242	·9072	88	·8405	·8282
22	·9740	·9690	56	·9221	·9049	89	·8373	·8256
23	·9729	·9677	57	·9200	·9027	90	·8339	·8229
24	·9719	·9664	58	·9178	·9004	91	·8306	·8203
25	·9709	·9651	59	·9156	·8981	92	·8272	·8176
26	·9698	·9637	60	·9134	·8958	93	·8237	·8149
27	·9688	·9622	61	·9112	·8935	94	·8201	·8122
28	·9677	·9607	62	·9090	·8911	95	·8164	·8094
29	·9666	·9592	63	·9067	·8888	96	·8125	·8065
30	·9655	·9577	64	·9044	·8865	97	·8084	·8036
31	·9643	·9560	65	·9021	·8842	98	·8041	·8006
32	·9631	·9544	66	·8997	·8818	99	·7995	·7976
33	·9618	·9526	67	·8973	·8795	100	·7946	·7946
34	·9605	·9508						

TABLE No. 89

Percentages of Absolute Alcohol in Aqueous Solutions

Specific Gravity.	100 Volumes contain volumes		Contraction.	Specific Gravity.	100 Volumes contain volumes		Contraction.
	Alcohol.	Water.			Alcohol.	Water.	
1·0000	0	100·000	0·000	0·9323	51	52·705	3·705
0·9985	1	99·055	0·055	0·9303	52	51·711	3·711
0·9970	2	98·111	0·111	0·9283	53	50·716	3·716
0·9956	3	97·176	0·176	0·9263	54	49·722	3·722
0·9942	4	96·242	0·242	0·9242	55	48·717	3·717
0·9928	5	95·307	0·307	0·9221	56	47·712	3·712
0·9915	6	94·382	0·382	0·9200	57	46·708	3·708
0·9902	7	93·458	0·458	0·9188	58	45·693	3·693
0·9890	8	92·543	0·543	0·9156	59	44·678	3·678
0·9878	9	91·629	0·629	0·9134	60	43·664	3·664
0·9866	10	90·714	0·714	0·9112	61	42·649	3·649
0·9854	11	89·799	0·799	0·9090	62	41·635	3·635
0·9843	12	88·895	0·895	0·9067	63	40·610	3·610
0·9832	13	87·990	0·990	0·9044	64	39·586	3·586
0·9821	14	87·086	1·086	0·9021	65	38·561	3·561
0·9811	15	86·191	1·191	0·8997	66	37·526	3·526
0·9800	16	85·286	1·286	0·8973	67	36·492	3·492
0·9790	17	84·392	1·392	0·8949	68	35·457	3·457
0·9780	18	83·497	1·497	0·8925	69	34·423	3·423
0·9770	19	82·603	1·603	0·8900	70	33·378	3·378
0·9760	20	81·708	1·708	0·8875	71	32·333	3·333
0·9750	21	80·813	1·813	0·8850	72	31·289	3·289
0·9740	22	79·919	1·919	0·8825	73	30·244	3·244
0·9729	23	79·014	2·014	0·8799	74	29·190	3·190
0·9719	24	78·119	2·119	0·8773	75	28·135	3·135
0·9709	25	77·225	2·225	0·8747	76	27·080	3·080
0·9698	26	76·320	2·320	0·8720	77	26·016	3·016
0·9688	27	75·426	2·426	0·8693	78	24·951	2·951
0·9677	28	74·521	2·521	0·8665	79	23·877	2·877
0·9666	29	73·617	2·617	0·8639	80	22·822	2·822
0·9655	30	72·712	2·712	0·8611	81	21·747	2·747
0·9643	31	71·797	2·797	0·8583	82	20·673	2·673
0·9631	32	70·883	3·883	0·8555	83	19·598	2·598
0·9618	33	69·958	2·958	0·8526	84	18·514	2·514
0·9605	34	69·034	3·034	0·8496	85	17·419	2·419
0·9592	35	68·109	3·109	0·8466	86	16·324	2·324
0·9579	36	67·184	3·184	0·8436	87	15·230	2·230
0·9565	37	66·250	3·250	0·8405	88	14·125	2·125
0·9550	38	65·305	3·305	0·8373	89	13·011	2·011
0·9535	39	64·361	3·361	0·8339	90	11·876	1·876
0·9519	40	63·406	3·406	0·8306	91	10·751	1·715
0·9503	41	62·451	3·451	0·8272	92	9·617	1·617
0·9487	42	61·497	3·497	0·8237	93	8·472	1·472
0·9470	43	60·532	3·532	0·8201	94	7·318	1·318
0·9452	44	59·558	3·558	0·8164	95	6·153	1·153
0·9435	45	58·593	3·593	0·8125	96	4·968	0·968
0·9417	46	57·618	3·618	0·8084	97	3·764	0·764
0·9399	47	56·644	3·644	0·8041	98	2·539	0·539
0·9381	48	55·669	3·669	0·7995	99	1·285	0·285
0·9362	49	54·685	3·685	0·7946	100	0·000	0·000
0·9343	50	53·700	3·700				

INDEX

THE END

Printed by R. & R. Clark, Limited, *Edinburgh*.

JOHN McNEIL AND CO.

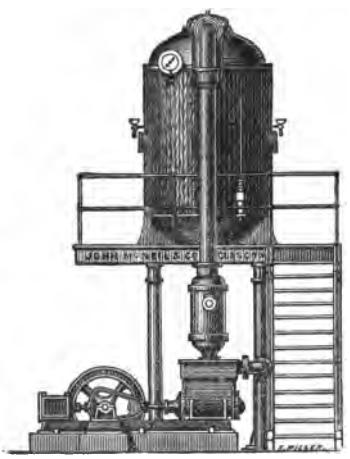
(Formerly AITKEN, McNEIL AND CO.)

Engineers.

GLASGOW.—Colonial Iron Works, Govan. *Telegrams.*—"Colonial," Glasgow.

LONDON.—35 Queen Victoria Street, E.C. *Telegrams.*—"Idustria," London.

SINGLE
DOUBLE
TRIPLE



QUADRUPLE
EFFET
EVAPORATORS.

McNEIL-LEWKOWITSCH PATENT EVAPORATOR FOR SOLUTIONS FROM WHICH SALTS *SEPARATE.*

SOAP, CANDLE, OIL REFINING,

and

CHEMICAL PLANTS.

GLYCERINE RECOVERY,

and

GLYCERINE REFINING PLANTS.

Second Edition. Revised and Enlarged. 8vo. 25*s. net.*

CHEMICAL ANALYSIS

OF

OILS, FATS, AND WAXES

AND OF THE

COMMERCIAL PRODUCTS DERIVED THEREFROM

FOUNDED ON BENEDIKT'S SECOND EDITION OF "ANALYSE DER FETTE"

By Dr. J. LEWKOWITSCH, F.I.C., F.C.S.

NATURE.—"The book is unique, the analyst will find in it practically all the available information upon the subject up to date, with full references to the original papers; and it will increase the author's already high reputation."

OILS, COLOURS, AND DRYSALTERIES.—"The authors are to be congratulated as to the result of their labours in searching through the immense mass of material necessary for the production of this elaborate treatise. As a work of reference it will doubtless long remain a standard work on the subject."

ANALYST.—"No chemist who is called on to analyse fatty bodies can afford to be without the book."

CHEMICAL NEWS.—"Will prove of the utmost value to all persons using oils and fats in the arts—and they are a very numerous body—as well as to analysts. Dr. Lewkowitsch has greatly enriched our technical literature by reproducing Prof. Benedikt's work in an English dress."

TEXTILE RECORDER.—"It is impossible to even cursorily glance through the book without being convinced that the author is thoroughly master of his subject, and that he has brought to bear on this work not only great conscientiousness as a compiler, but also extensive practical knowledge."

SOAPMAKER.—"Although it is the duty of a reviewer to find fault, we have been unable to discover any sins, either of omission or of commission, that are worthy of mention; and we consider Dr. Lewkowitsch's modification of Dr. Benedikt's work an important addition to the technology of soap and candle making."

CHEMICAL TRADE JOURNAL.—"As a whole the work is an excellent laboratory handbook of oil and fat analysis, invaluable to all those connected with these industries, being well arranged and easy of reference."

CHEMIST AND DRUGGIST.—"We commend this book with perfect confidence to the analyst, the technologist, the pharmacist, or, indeed, to all who have any interest in the scientific aspect of the oil question."

ENGINEER.—"The book is a good one, and will be bought, as a matter of course, by every chemist engaged in the examination of fats, waxes, and their products."

MACMILLAN AND CO., Ltd., LONDON.

REYNOLDS AND BRANSON, Ltd.

Chemical and Scientific Instrument Makers,

DEALERS IN AND MANUFACTURERS OF PURE CHEMICALS AND GLASS APPARATUS.

Combined Chemical and Physical Bench fitted for Gas, Water, and Electricity as recently supplied to the National Physical Laboratory, Teddington. Designs of Benches and Plans of Technical and other recently fitted Laboratories supplied on application.

Chemical Balances of great Accuracy and Durability. Suitable for Technical Research or Works Laboratories, with all Agate Bearings, Rider Scale, and Beam designed on the most modern principles. Enclosed in Elegant Glass Case. Total load 200 grms. sensitive to one-tenth mgm. **£7 : 15s.** and **£9 : 10s.**

Special Cheap Balance, suitable for Elementary Analysis or for Rough Weighing. To carry 100 gram. and turn with 1 mgm. Price **£1 : 9s.**

Specific Gravity Instruments of all kinds. Viscosimeters and Surface Tension Apparatus.

Special Appliances made in our own workshops under skilled superintendence.

LARGE ILLUSTRATED CATALOGUE OF

CHEMICAL AND PHYSICAL APPARATUS

350 pages. 1200 Illustrations. Free to Customers.

Also Catalogues of the following :—

Microscopes and Accessories. Photographic Apparatus.
Optical and Dissolving View Lanterns. Compressed Gases.
Technical and Educational Slides on Sale or Hire.
Electric and Galvanic Apparatus.
Mercurial and Aneroid Barometers and Thermometers.
Opera, Marine, and Field Glasses. Spectacles, etc.
X-Ray Outfits and Static Machines.

---

14 Commercial Street, Leeds.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

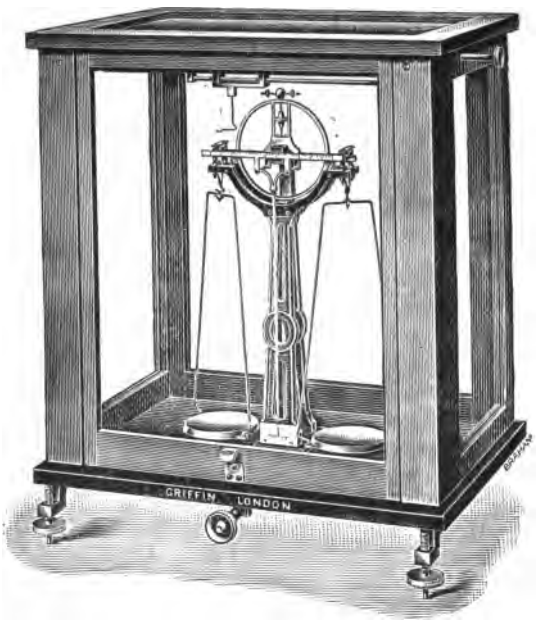
1163-69 086 (new preface)

JOHN J. GRIFFIN & SONS, Ltd.

20-26 SARDINIA STREET, LINCOLN'S INN FIELDS, LONDON, W.C.

MANUFACTURERS AND IMPORTERS OF CHEMICAL APPARATUS AND CHEMICALS.

ASSAYERS' SUPPLIES.



SPECIALITIES:

Balances of Precision sensitive to 1-200th of a Milligram.
Bohemian and Jena Glass, Beakers, Flasks, Retorts, Funnels, etc.
Furnaces for Gas, Coal, Coke, Charcoal, Gasoline, Benzoline, and Electric Power.

IMPROVED CRUSHERS and GRINDERS.

Will Pulverise the Hardest Rock to a 200 Mesh Powder.

NEW APPARATUS IN METAL OR GLASS MADE TO ORDER IN OUR OWN WORKSHOPS.

Copying not permitted